MARINE REVIEW

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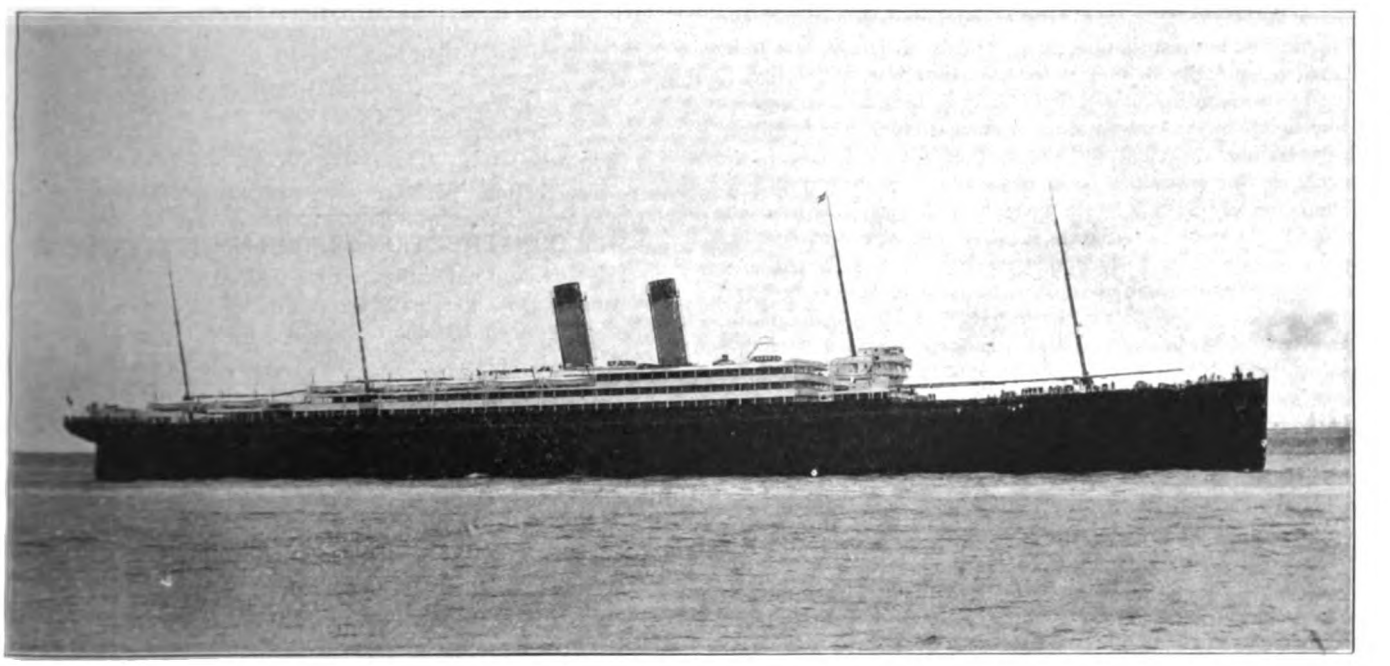
BALTIC, LARGEST VESSEL AFLOAT.

Liverpool, June 27.—It is an interesting coincidence that the year which witnesses the triumph of the greatest of the many great exhibitions Americans can proudly look back upon, should also welcome the advent of the Baltic, the latest White Star leviathan and incontestably the mightiest steamer ever launched. The Baltic has just arrived in the Mersey from the yard of the builders, Messrs. Harland & Wolff, Belfast. She will sail on her maiden voyage on Wednesday next, and is due in New York on July 7. Undoubtedly her arrival will afford convincing ocular proof that the White Star Line intends to maintain its reputation as forerunner of those combined comforts in ocean travel which have long since won it so honorable a name. The possession of the two largest steamers afloat on any seas, the Cedric and the Celtic, each of 21,000 tons gross register, has not represented finality. The Baltic registering as she does 24,000 exceeds them by 3,000 tons. Her capacity for cargo is about 28,000 tons, and the displacements at her load draught is about 40,000 tons. She is 726 ft. in length, or 26 ft. longer than the steamers above named, which with her two great funnels and four pole masts she strongly resembles. The symmetry of her hull is so perfect that it is only when in juxtaposition to other craft that the steamer's tremendous size is apparent; but as will be seen from an account of her internal accommodation, the like sense of proportion in regard to passengers' quarters is equally distinctive. The Baltic is fitted with engines of Harland & Wolff's quadruple-expansion type, arranged on the balanced principle which practically does away with vibration and will steam about 17 knots. She is thus primarily intended to meet the want of an increasing number of travelers whose first desire is not great speed but the largest modicum of comfort coupled with moderate speed. Experience having shown that this desideratum is fulfilled in the Cedric and Celtic, it merely remained for the White Star Line to introduce a vessel of the same type, but still further improved by the addition of such minor embellishments as only a careful and far seeing management could anticipate. The Baltic can carry 3,000



WHITE STAR LINER BALTIC, LARGEST VESSEL IN THE WORLD.

passengers besides a crew of about 350. All her first class accommodation is amidships. The grand dining saloon, situated on the upper deck, is a very handsome apartment, and extends the full width of the ship, 75 ft. It has seating accommodation for 370 people, is exceptionally lofty and airy, and with its effective scheme of decoration which unites artistic taste and brightness of aspect, can claim to be one of the most palatial saloons on the Atlantic. The first class smokeroom and library on the upper promenade deck are also luxurious apartments, wherein everything that tends to the comfort of passengers is apparent, whilst the staterooms have been devised to meet the wants of the most fastidious traveler. They consist among others of single berth rooms, of which type, it may be noted the White Star Line was the originator, and rooms en suite, these latter consisting of bed, sitting and bath rooms for such as are prepared to pay for the extra privacy enjoyed. Immediately abaft the first class accommodation is that of the second class, whose interests have been carefully watched. To the voyager of but a decade or two ago, the size and decorations of the dining saloon, smokeroom and library will come as a revelation, and the staterooms in comfort and ventilation are in every way excellent.

With the exception of a limited space forward, the third class passengers are provided for abaft the second class. For no section of the travelling public have greater improvements been made on ocean steamships in recent years than for the third-class, whose quarters on the Baltic consist of commodious dining rooms (fitted with tables and revolving chairs) where passengers are waited upon—as in the other steamers of the line—by stewards; comfortable smokerooms, and a large number of two, three and four berth staterooms. The heating and ventilating arrangements of the ship are most complete, and the Baltic having such huge cargo capacity, is fitted with winches and other loading and discharging arrangements of the latest and most efficient type. She has large refrigerating chambers for the carriage of chilled beef, the machines for working same being on the C-O^2 principle. The command of this latest wonder of the seas has been entrusted to Lieut. E. J. Smith, R. N. R., an officer of ripe experience, who is well known to travelers across the Atlantic as having hitherto had charge of the popular Majestic. With the addition of the Baltic, the White Star Line's magnificent fleet now consists of thirty-one steamers—besides tenders—the aggregate tonnage of which amounts to the huge total of just 360,000 tons. Of these thirty-one steamers, no fewer than twenty-seven are fitted with twin screws whilst twenty-one are each over 10,000 tons, as a result of which latter fact, the average tonnage of the White Star steamers is immeasurably greater than that of any other line, and as been seen, it possesses in the Baltic, Cedric, and Celtic, the three largest vessels afloat. Mention should, too, be made of the well known Oceanic 17,300 tons, than which no more luxurious steamer crosses the Atlantic. It is of further interest to note that the passenger services of the White Star Line are maintained by twin-screw steamers only.

SPEED OF KAISER WILHELM II.

The North German Lloyd steamer Kaiser Wilhelm II constructed last year at Stettin has succeeded in maintaining the highest average speed crossing the Atlantic ever placed to the credit of any ship. Her average speed for the entire voyage was 23.58 knots while on the last day of the trip the mean speed was 24.35 knots. She took the southerly course running 3,112 nautical miles, and the time taken up was 5 days 11 hours 58 minutes which is rather longer than in some of the trips when record speeds were obtained, but the speed from an engineering point of view, which is the important point, is the best ever made by an Atlantic vessel. This speed of 23.58 knots compares with the 23.51 knots made by the Deutschland in June, 1901. A notable feature about the performance of the Kaiser Wilhelm II is that her propellers have been fitted with four new blades of considerably increased surface and during the trip these propellers made a mean of about 79 revolutions per minute, while the average power of her engines was 44,600 I. H. P. The former best average for this ship was 22.9 knots, and there is reason to believe, now that she is finding herself, that she will do even better. Great Britain has no ship at present capable of a higher average than 22 knots, but the Cunard Steamship Co. is under contract to maintain with its two flyers now building an average speed of 25 knots. To maintain this speed, of course, the vessels must be capable of making 26 knots or more.

COST OF MOVING FREIGHT PER 100 MILES.

At the meeting before the rivers and harbors committee held in Washington to discuss the project of building a ship canal to Tonawanda around the Niagara rapids at the outlet of Lake Erie Mr. J. J. Hill, president of the Great Northern railway made a striking address in which he practically stated that water transportation was economical only when deep draught could be secured. He stated that within a certain draught the railways were able to haul freight cheaper than waterways, and referred to the decline of the river transportation as a proof of it. Incidentally he mentioned the fact that the average rate paid by the public per ton for moving freight per 100 miles was far lower in the United States than it was in any other country. These figures were not incorporated in the transcript of his remarks, but the Review has now been favored with them from Mr. Hill. They are as follows:

Great Britain	$2.30
France	2.00
Austria	2.05
Germany	1.88
Russia	1.75
United States	0.72

SHIP CONSTRUCTION IN THE UNITED STATES.

The bureau of navigation reports 1,092 sail and steam vessels of 349,573 gross tons built in the United States and officially numbered during the quarter ended June 30, 1904, as follows:

	Wood.				Steel.				Total.	
	Sail.		Steam.		Sail		Steam.			
	No.	Gross.	No.	Gross.	No.	Gross	No.	Gross.	No.	Gross.
Atlantic and Gulf.	318	47,868	282	14 795	5	15,374	47	97,981	652	176 018
Porto Rico.	7	129	....	.....	....	.....	....	.....	7	129
Pacific.....	30	7,036	116	13,949	....	.....	4	1,211	150	22,196
Hawaii.....	....	....	1	8	....	.....	....	.....	1	8
Great L'k's	4	144	48	1,260	....	.....	41	139,898	93	141,302
Western Rivers..	....	....	188	9,879	....	.....	1	41	189	9,920
Total .	359	55,177	635	39 891	5	15,374	93	239,181	1092	349,573

During the corresponding quarter ended June 30, 1903, 1,215 sail and steam vessels of 376,502 gross tons were built in the United States and officially numbered, as follows:

	Wood.				Steel.				Total.	
	Sail		Steam.		Sail.		Steam.			
	No.	Gross.	No.	Gross.	No.	Gross.	No.	Gross.	No.	Gross.
Atlantic & Gulf.....	402	52,795	260	15,089	7	12,541	59	106,796	788	187 221
Porto Rico.	10	112	....	....	....	....	....	....	10	112
Pacific.....	51	18,542	102	11,046	....	....	5	10,493	158	40,081
Hawaii.....	1	6	2	16	....	.....	....	.....	3	22
Great L'k's	16	5,690	52	2,794	....	.....	41	131,660	109	140,114
Western Rivers...	1	11	140	5,985	....	.....	6	2,956	147	8,952
Total....	541	77,126	556	34,930	7	12,541	111	251,905	1215	376,502

Unrigged, June 30, 1904, 216 vessels, 51,844.
Unrigged, June 30, 1903, 320 vessels, 79,574.

REPORT OF SHIPPING COMBINATION.

The first annual report of the International Mercantile Marine Co., covering the operations of the twelve months ended Dec. 31, 1903, was submitted to the stockholders last week. It shows total gross earnings of $31,037,420, net earnings of $4,000,522 and a surplus after the payment of fixed charges, interest on loans and the English income tax of $355,295. There is, however, the item of $1,442,502 paid into the insurance account in excess of the requirements of the year, which came directly out of income.

The showing was favorably received in financial circles, where the surplus rather exceeded expectations. It is equal to 0.69 of 1 per cent on the preferred stock. The report, which is signed by J. Bruce Ismay, president, and C. A. Griscom, chairman of the board, calls attention in detail to the depressed condition of the ocean carrying trade during the past year, but does not comment on the outlook, nor refer to the steerage rate war. The report continues:

"This report covers only the first year of the company's existence, during which the efforts of the management have been directed toward organizing and systematizing the business. Much that at the time of organization was hoped to be accomplished, in the way of avoiding needless expenditures and of establishing harmonious co-operation among the subsidiary companies, has been successfully achieved; many important economies have been effected during the year, and the outlook for further improvement in this direction is gratifying. The management felt it of great importance to proceed with caution in making radical changes in the organization and conduct of the business and consequently the operations of the year 1903 reflect to a very limited extent the benefits which it is believed will accrue from the changes which have been made. It has not been practicable within the period covered by this report to complete the arrangement of a uniform system of accounting for the various companies which would make it possible to present a consolidated balance sheet. The combined income account of the subsidiary companies for the year 1903 is presented herewith, showing a surplus income for the year of $1,797,797, after meeting all fixed charges and operating expenses, in which operating expenses are included all charges for repairs, maintenance and overhauls.

Income account for 12 months ended Dec. 31, 1903:

Gross voyage earnings		$29,677,756
Miscellaneous earnings		1,359,664
Total		$31,037,420
Gross expenses		27,036,898
Net earnings		$ 4,000,522
Interest on bonds	$3,083,346	
Interest on loans	441,218	
Income tax	120,663	
		3,645,227
Leaving surplus earnings		$ 355,295
Surplus insurance account		1,442,502
Total for one year		$ 1,797,797

"This does not include the operations of the Leyland Line or the National Line, in which your companies have important interests, except to the extent of any dividends received on the shares held by your companies. As appears from the income account, the gross earnings of your companies aggregate over $31,000,000, not including the gross earnings of the Leyland and National lines, which amount to about $6,500,000 more, making the aggregate gross earnings of the fleet for the year nearly $37,500,000. With harmonious co-operation among the several lines and the elimination of unnecessary duplication of expenditures, it seems reasonable to expect that the ratio of operating expenses to earnings should be substantially diminished and that out of such large gross earnings the net return for future years should be increased over the result of this year."

In regard to the ocean freight rate situation, the report says:

"The earnings of those of the companies which are principally engaged in freight traffic on the North Atlantic have been seriously affected by the extreme depression in freights which prevailed during the year, and by the embargo placed upon cattle shipments from New England points. The operations of the Leyland and National lines, for example, in which your company owns large interests, resulted in actual losses for the year. The Leyland Line was compelled, as shown by its annual report to the stockholders, to transfer to profit and loss from its reserve fund £60,500 in order to provide for depreciation and to meet its debenture interest and the dividend on its preferred stock for the six months to May 31, 1903, and to cover the actual loss of £80,780 18s 9d, sustained in operations for the year. Your company consequently received no return upon its investments in these companies except one semi-annual dividend upon the Leyland Line preferred stock.

"In order to appreciate the extent that unfavorable business conditions prevailing during the year affected the earnings of the companies, it may be interesting to state that the aggregate annual earnings of the subsidiary companies, as shown by their books for the five years prior to 1903, before deducting depreciation, but eliminating any unusual earnings from government charters, amounted to $6,510,071. Such earnings were derived, of course, only from the ships actually in service, which did not include a large part of the new tonnage now in operation. Taking the average rate earned per ton during the five years and applying that rate to the tonnage actually in service during 1903, net earnings of about $9,500,000 would have been shown, without taking into account any savings in expense brought about by the harmonious co-operation of the several lines under the co-ordinate management which is now assured.

"The company has inaugurated the system of insuring its own ships to a large extent, it being deemed that this could be done advantageously and safely with such a large fleet as the company commands. Under this system an insurance fund has been established into which the premiums are paid and against which all losses and premiums paid for additional insurance are charged. The premiums are paid into the fund in cash and are charged directly into operating expenses."

The report goes into the financial details of the organization of the company, most of which have already been made public. It appears here for the first time that the remainder, or $7,000,000, of the $20,000,000 authorized issue of 5 per cent bonds of the International Navigation Co. (American and Red Star lines) were issued during 1903, the proceeds being applied to payment for ships previously contracted for. In the purchase of the White Star and Dominion lines and the business and good will of Ismay, Imrie & Co. and Richards, Mills & Co., 25 per cent was paid in cash, amounting approximately to $11,000,000. This was paid out of the proceeds of the $50,000,000 4½ per cent bonds of the parent company, in regard to which the report adds:

"There was also paid in cash out of said sum of $50,000,000 the expenses of the new organization, including counsel fees and the very heavy transfer duties charged on the transfer of the properties in England, an aggregate amount of $652,429. The balance of said $50,000,000, has been invested in the properties, for the purchase of the shares in the Leyland Line above mentioned, for new tonnage previously contracted for, and the companies. No payments therefrom have been made for commissions or profits of any kind to any person or corporation whatsoever.

"The greatly increased efficiency and value of the properties

of your company, from the large expenditures for new tonnage, is apparent when it is considered that nearly 50 per cent of the gross tonnage consists of new vessels of the most improved type and construction."

The report gives the following details in regard to the company's fleet:

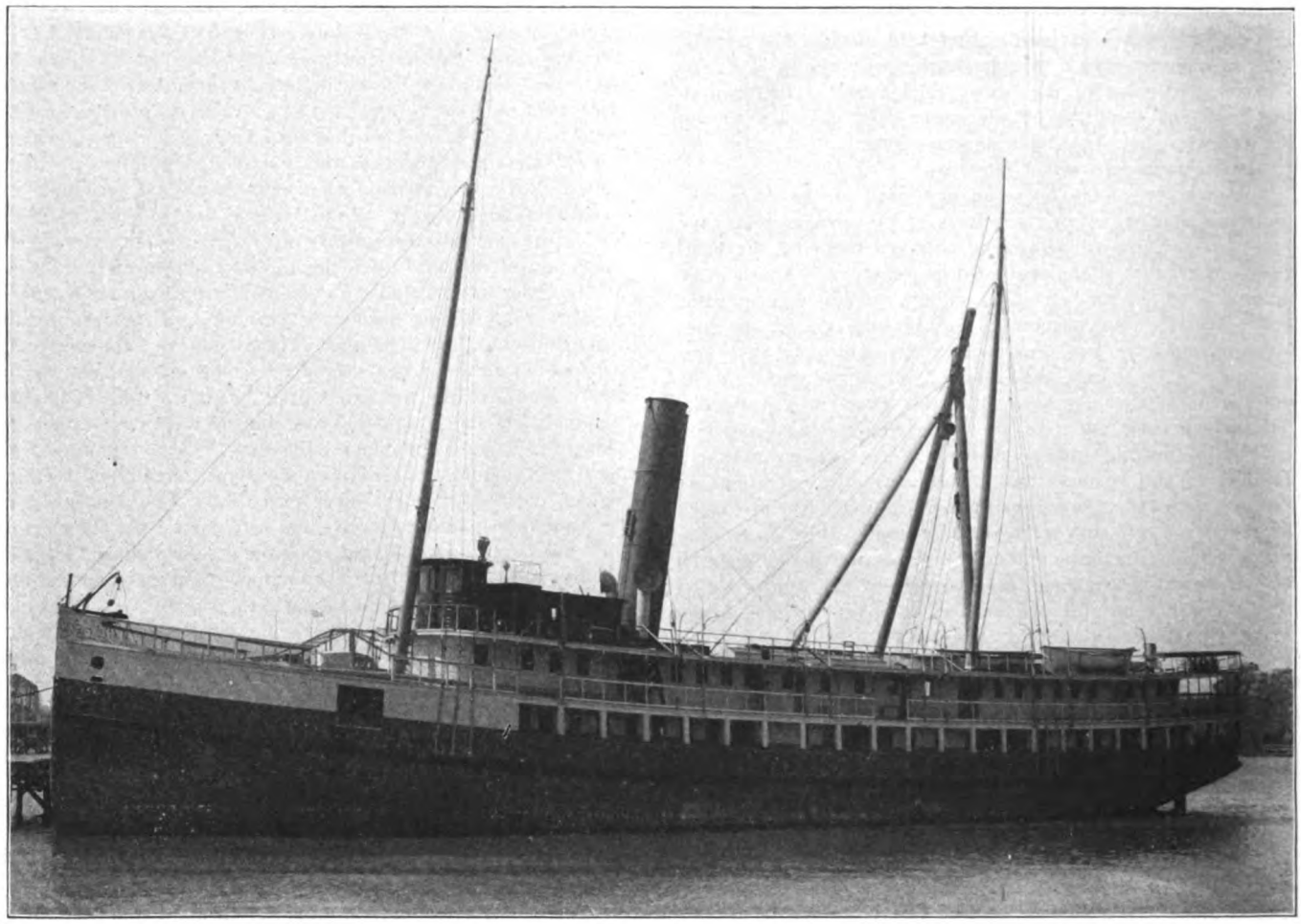
The number of steamers in service, including the subsidiary lines, represents a gross tonnage of 992,110 tons. New tonnage of 90,000 tons is now building, under contracts made by subsidiary companies prior to Dec. 1, 1902, which, when completed, will increase the total gross tonnage to 1,082,110 tons.

The number of steamships now in service is 133; this does not include the many tugs, barges, lighters and grain elevators at different ports. Of the vessels now in service there are: Two steamships under 1,000 tons gross; thirty-eight steamships between 1,000 and 5,000 tons gross; fifty-nine steamships between 5,000 and 10,000 tons gross; twenty-nine steamships between 10,000 and 15,000 tons gross; three steamships between 15,000 and 20,000 tons gross; two steamships over 20,000 tons gross; total, 133 steamships.

Of these fifty-eight are twin screw steamships, seventy-five single screw ships. Of such ships sixteen are built of iron, the remaining 117 are built of steel. Of the total gross tonnage, only 3 per cent was built prior to 1880, 11 per cent between 1880 and 1890, 43 per cent between 1890 and 1900, and, including the four ships now building thirty-nine ships, representing nearly 50 per cent of the entire gross tonnage, will have been built since 1900.

PACIFIC COAST STEAMSHIP CABRILLO.

The Cabrillo, recently built at the yard of Banning Bros., Wilmington, Cal., has just gone into commission and has established an enviable record for a steamer of her size, making over 16 miles per hour over the government course in San Francisco bay. Her engines were supplied by the United Machine Works of San Francisco. The Cabrillo was built especially to run between San Pedro and Santa Katalina island. This island lies 30 miles off the coast of Southern California and the present vessels make the trip in about 2¾ hours. It is expected that the Cabrillo will reduce the time over an hour. She is 192 ft. long, 32 ft. beam and 12½ ft. deep, equipped with quadruple-expansion engines with cylinder diameters 18½, 32, 38 and 38 in. She burns oil exclusively. The Cabrillo is very beautifully fitted up and is one of the handsomest steamers in the Pacific coast trade.



PACIFIC COAST STEAMER CABRILLO.

[Built by Banning Bros., Wilmington, Cal.

The United States Steel Corporation has been investigating for some time the iron ore beds that it owns and as a result of the investigation the quantity is estimated at 750,000,000 tons. This includes all ore property owned or controlled by the corporation. The total output of its mines in the Lake Superior region in 1902 was 16,063,179 tons as compared with 15,363,355 tons in 1903.

The big grain elevator of the Boston & Maine Railroad Co., together with the company's freight houses at Mystic Wharf, Charleston, were burned last week entailing a loss of $1,000,000.

IMPORTANT BRITISH TURBINE INVENTION.

Liverpool, July 4.—An important invention affecting steam turbines and one which provides a solution to the one difficulty which has hitherto puzzled engineers and others since the new motive energy was introduced has just been perfected at St. Helens, near Liverpool. The power and efficiency of steam turbines is now acknowledged, and the one drawback to their general adoption for naval purposes has been the fact that, while they have provided enormous power for a forward movement, there lacked an invention to give the same power and speed in the reverse direction. Turbines have, however, been able to go astern, but this has been done at some sacrifice of the forward efficiency, and the results, so far as the backward movement is concerned, have not been altogether satisfactory. So great has this difficulty been acknowledged that Professor Rateau of Paris, the well known expert of the French government, in a paper read at the last session of the Institution of Naval Architects in London, expressed the opinion that no turbine could be constructed that would give the same power and efficiency both ways without a great loss of the general efficiency of the turbine. But that difficulty has just been overcome as the result of a long and patient series of experiments and tests which have been carried out at the works of Messrs. John Forster & Co., Ltd., engineers and boiler makers of St. Helens, Lancashire, and a steam turbine has been there erected which gives exactly the same speed, power and efficiency in both directions. It is needless to say that the invention has been patented in every civilized country of the world, and the full patent rights as affecting Great Britain have been completed only today, July 2. The importance of the new invention is testified by the fact that already the British admiralty authorities have had a representative at Messrs. Forster's works inspecting the new machine, while many of the principal ship building firms have also sent their experts on the same errand. The admiralty inspector is expected to pay another visit in the near future. It is remarkable that in practically every case, it has been reported that the reversing difficulty has at last been solved. On Thursday, June 30, by the courtesy of Alderman John Forster, head of the firm of Messrs. Forster & Co., a number of press representatives and others interested were shown the new machine in actual operation. It was explained that the new turbine is the invention of M. Jeremias Ferri, a representative of the Argentine Republic at present staying at St. Helens, and it has been constructed from his drawings and under his supervision, in conjunction with Mr. John Forster at the works of Messrs. Forster & Co. The present turbine has only three sets of discs, working a 12-H. P. or 25 amps. dynamo by an ordinary belt, and it attains a speed of from 1,500 to 2,000 revolutions per minute. Certain valves and vanes forming the basis of the patent, work with absolute accuracy and smoothness, and every expert who has seen the turbine in motion has spoken highly of the simplicity and thorough success of the starting, stopping and reversing operations. The semi-official trial on June 30 was successful in every way. The turbine attained full speed in the course of a few seconds and by the simple movement of a lever, full speed in the reverse direction was attained in exactly 16 seconds. Various tests were made and it was clearly demonstrated that the turbine can be reversed when under a full load with perfect freedom by the movement of valves which can be regulated while the turbine is running, without touching the steam valve. It was also shown that the steam can be shut off at any desired point in the expansion from one series of discs to the next, and it was clearly demonstrated that the turbine is all that the contractors claim for it. It may be added that M. Ferri, the inventor, was trained in some of the best ship building yards of this country, where he is well known, and was educated at University college, Liverpool.

The British consul general at Havre states that a British line of steamers has been started, called the Canadian Lines, Ltd., running twice a month from Rotterdam, calling at Havre, for Quebec and Montreal, taking both passengers and cargo. This line has been subsidized by the Canadian government and is already carrying a large number of emigrants, and first-class passengers. In the opinion of the consul general, it looks as if the great difficulty which has attended the establishment of a line of steamers between Continental ports and Canada has been overcome.

I learn that the first of the three huge Cunard liners now being built at Clydebank by Messrs. John Brown & Co. is to be launched on July 13. The vessel is the Caronia, one of the two 21,000-ton sister ships. She is to be fitted with engines of the reciprocating type driving twin screws, but her sister ship the Carmania will be equipped with turbine engines, distributing power through three shafts, each driving one propeller. At Clydebank the keel plate of one of the Cunard express turbine steamers which is to be 790 ft. long and of 24,500 tons, has just been laid. She is designed to work with quadruple screws and to make 25 knots, which will make her the largest as well as the fastest ocean liner in the world. The names of the two turbine express steamers have not been chosen, but there appears to be a consensus of popular opinion in favor of Britannia and Columbia, the former recalling to mind the diminutive pioneer Cunarder of that name, which first cleaved American waters 64 years ago and was in her day the finest ship afloat, while the Columbia is suggested by way of a compliment to the American people who support and display an equal pride in the fine Cunard fleet.

In regard to the new departure of Messrs. Elder, Dempster & Co. which has for its object the development of Canadian trade with South Africa, I have received from the firm a communication in the following terms: Having taken up the steamship service between Canada and South Africa by arrangement with the Canadian government, we are naturally desirous of doing all possible to promote the trade between the two colonies. We believe there are great possibilities, but so far there has been a lack of effort to secure for Canada the share she ought to have of the Cape trade. Therefore, with a view of promoting more interest and doing what we can towards bringing the two colonies into closer business relationship, we have decided upon an exhibition movement, by placing at the disposal of the Canadians, entirely free of charge, a certain number of passages, as well as room for samples of goods, each passenger representing a particular branch of commerce being allowed a section of about 10 to 20 tons capacity in the 'tween decks to place the goods for exhibition at the different Cape ports. The selection of exhibitors to be made mutually by our Montreal representative, the president of the board of trade at Montreal and the secretary of the Canadian Manufacturers' Association at Toronto. The steamers we propose for this are the Melville and the Monarch, the latter of which leaves Montreal about the middle of July for Capetown, Port Elizabeth, East London and Durban.

The announcement is made of the purchase by the Cincinnati, Hamilton & Dayton Railroad Co. of the Pere Marquette and Chicago, Cincinnati & Louisville railroads. The new system will be known as the Cincinnati, Hamilton & Dayton railroad and Eugene Zimmerman of Cincinnati has been elected president. This deal creates a new railroad system of great importance extending over 5,000 miles of road and reaching from Chicago to Buffalo and Cincinnati.

The steamship Minnesota, one of the largest vessels in the world, has been chartered to carry coal from New York to the Pacific coast. She was built for the Great Northern Steamship Co. by the Eastern Ship Building Co. at New London, Conn. She is expected to carry over 20,000 tons.

MORE ORDERS FOR TURBINE STEAMERS.

Liverpool, July 4.—Following the example set by many of the channel services in Britain, the Belgian government has just ordered three turbine mail and passenger steamers to be built to run in the Dover-Ostend service. The contract for the first of these has been placed with the Cockerill company. The vessel will be 310 ft. long, and 40 ft. beam, with a speed of 22½ knots which will enable the voyage to be done in 2 hours, 40 minutes. The new steamer is to be a magnificent vessel and is likely to surpass in every particular anything of her class yet afloat. In dimensions she will be larger than the latest steamer of the line, the Princess Clementine, while in decoration and fittings she is to be even more beautiful than that ship, which with other steamers of the Belgian government fleet have, as channel steamers, won the highest tributes of praise from those who continually journey by the more luxurious ocean liners. The ship will be entirely fitted throughout with electric lights and will also have a very powerful electric searchlight. Electric cranes will also be fitted fore and aft to facilitate the embarkation and disembarking of mails and luggage, and like other steamers of the fleet, she will have the very latest appliance of the Marconi wireless telegraphy installed on board, not only for the requirements of the service, but also for private messages from passengers journeying by the route. The steamer is to be delivered for immediate service early next year, in time for the enormous influx of visitors likely to cross for the great 1905 International Exhibition at Leige, and for the throngs who cross to Ostend every summer.

I am able to give the following additional particulars of the turbine steamer, Manxman, launched a week ago by Messrs. Vickers, Son & Maxim, Ltd., for the Midland Railway Company for their new steamship service from Heysham to Ireland. The speed guaranteed by the builders is 20 knots, but it is not improbable that a rate of 22 knots will be realized. Of the three other vessels being built to form the service, viz. the Antrim, Donegal, and Londonderry, the latter as well as the Manxman is to be fitted with Parsons turbines, but there is this important difference in the Manxman that the steam pressure will be 200 lb. instead of 150 lb. as in the case of all marine turbines so far fitted. As the two turbine driven ships are almost identical, there will be an opportunity of ascertaining whether increased pressure improves the economy. The accommodation on the Manxman consists almost entirely of large saloons, instead of the small private cabin in the night steamers. But as the vessel may occasionally be required for the night service, one of the saloons on the upper deck has been arranged so that it may be converted on short notice into a number of small cabins. The dimensions of the vessel are: Length 330 ft., beam 43 ft., and depth 26 ft. The ventilation is a novel feature; it is carried out on Stewart's thermo-tank system. This arrangement has been used very extensively in recent years on large emigrant vessels, such as those of the Cunard and American lines, but this is the first time it has been used on a channel steamer. It is an ingenious arrangement by which the air is extracted (in summer) by electric fans, and is circulated before delivery (in winter) through a coil of steam pipes. The steering-gear is of a novel type, being arranged to work either by electricity or steam. It is situated at the after end of the vessel, and controlled mechanically from the flying bridge.

Messrs. Swan, Hunter & Wigham Richardson, Ltd., of Wallsend-on-Tyne, have just booked an important order for a large pontoon dock from the port authorities of Vancouver. The details of the size and type of the dock have not yet transpired, but it is stated that the dock is intended for dry docking the largest class of ocean steamers, and will therefore constitute an important addition to the work in hand at the Wallsend establishment.

The Cunard Steamship Co. are being advised to name their two new express turbine steamers, Britannia and Columbia. It is said that as these two ships further link the old world with the new, those people by birth or descent settled on the other side of the Atlantic should also have consideration and their glorious country be represented in the name of the second boat.

The Allan Line steamship Ionian, which has arrived this week from Quebec and Montreal, reports that on the outward trip the liner covered the distance from Tory Island to Cape Race in 4 days, 23 hours, which is one of the fastest, if not the fastest passage on record for this route. On Saturday, May 28, the Ionian made 325 miles, on Sunday 364 miles, Monday 367 miles, Tuesday 330 miles, Wednesday 336, Thursday 384, and Friday 363 miles, arriving at Quebec at 11:30 p. m. on that day. Thursday's steaming of 384 miles is the Ionian's best yet.

LLOYD'S REGISTER OF AMERICAN YACHTS.

The second volume of the American Yacht Register published by Lloyd's Register of Shipping fully justifies the promise of the first volume, issued last year, and gives the yachtsmen what has long been needed, a thoroughly comprehensive directory of yachting. Much has been done during the year to correct and amplify the original information and in particular to keep pace with the great change which is now taking place in the sailing fleet through the installation of gasoline engines. The list of power yachts, which includes 1,019 vessels, shows a very large number of old sailing yachts, once well known as cruisers or racers, which are now auxiliaries. Very full details of the engines of these and of other types of gasoline vessels are given.

The list of sailing yachts includes 2,099 vessels, making a total of 3,118 yachts of over 25 ft. over-all length in use in the United States and Canada. In this list every section of the two countries is represented from British Columbia to Nova Scotia, and from Southern California to Maine and Florida.

The list of clubs includes 159, the burgee of each, with the officers for the year, and other particulars, being given. In addition, there are over 1,300 private signals of yacht owners, which, with the code flags and national ensigns, make up nearly sixty color plates of flags. The list of yacht owners includes nearly 3,000 names, with the address of each owner, the clubs to which he belongs, and the yachts owned by him.

A list is given of the yacht designers and builders of the United States, with the various yachts designed or built by them, the official signal letters of all yachts are given in a separate list, and also a list of former names of yachts.

A special feature of the book is the employment of the distinctive symbols of Lloyd's society to indicate the class and character of each vessel built under Lloyd's survey or specially classed by the society; thus giving an unimpeachable guarantee of the nature of the original construction and the manner in which the yacht has been kept up. Though new to this country, the building of yachts to Lloyd's rules and under the inspection of the society's surveyors is the common practice abroad, the owner reaping the benefit during his ownership of the vessel and also when he decides to offer her for sale. The book is published by Lloyd's Register of Shipping, 15 Whitehall street, N. Y. The price is $7.50 per volume.

The two French cruisers Democratie, being constructed at Brest, and the Verite, being built at Bordeaux, are each to be fitted with twenty-two Belleville water-tube boilers generating 18,000 H. P. With these additions the number of French naval vessels equipped with Belleville boilers is forty-eight, the total horse power being 475,500. The excellent results obtained with the Belleville type of boiler in the cruisers Sully, Admiral, Aube and Marseillaise is responsible for the adoption of this type in these two latest cruisers.

CANADIAN SHIPPING NOTES.

The steamer Valleyfield was considerably damaged by fire while at her dock, Valleyfield, Que., June 16.

The Dominion marine association is asking the Dominion government to undertake the deepening of the Wolfe island canal, near Kingston, Ont.

The lightship Anticosti, has been completed at the yard of the Polson Iron Works, Toronto, and has sailed for her station off Anticosti island, Que.

The steamer Turbinia arrived in Hamilton, Ont., June 19 and is being painted and fitted out there. She was expected to make her initial run to Toronto, July 1.

The Richelieu & Ontario Navigation Co. has completed the repairs on the Carolina, which was sunk in the Saguenay in 1898, and put her again on the Quebec-Saguenay run.

The cruiser Canada for the Dominion government has been launched at Barrow-in-Furness, Eng. The steamer is intended for the fisheries protection service on the Atlantic coast.

The steamer Gauss, recently purchased by the Dominion government for service in the Arctic seas, has been renamed the Arctic, and is being refitted and equipped for her work at Quebec.

The steamer Jubilee running on Lake Temiskaming, Ont., ran into the wharf at Harleybury, Ont., recently, and sank during the night, and a number of her passengers had narrow escapes.

A new steamer named the Elgin L. Lewis, for the freight and passenger trade on Lake Simcoe, has been launched at Orillia, Ont. She will have accommodations for 125 passengers.

It is reported that H. Calderwood, manager of the Collingwood Ship Building Co., has resigned. Jas. Smith, mechanical superintendent, and F. Johnston, are also reported to have resigned.

The Ottawa River Navigation Co.'s steamer Empress has been put on her run to Grenville, Ont., after having been rebuilt, and her passenger accommodations rearranged and improved.

The Richelieu and Ontario Navigation Co. is considering tenders for raising the sunken steamer Canada off Sorel. The cost of raising and re-equipping the steamer is placed at $80,000.

The Newfoundland government has directed a survey to be made of all the harbors on what was known as the "Treaty Shore," which will be open to development under the recent Anglo-French convention.

The Dominion Atlantic railway has placed one of its steamers—the Prince Arthur—on a route from Halifax, N. S., to New York, and the Red Cross Line, which heretofore has not had any competition, has cut the rate to $15 single and $25 return.

The Polson Iron Works Co., Toronto, proposes starting the construction of motor boats, and is acting as agent for the Thornycroft firm of London, Eng. A sample motor boat of 20 to 25 miles an hour has been brought out by F. B. Polson, and has just returned from England.

In 1902 D. O'Connor placed a small steamer on Lake Temagami, 72 miles north of North Bay, Ont., for freight and passenger trade. The increasing trade of the district, due to settlement and tourist travel has necessitated the addition of a second steamer. This is an 85-ft. boat and was purchased in England.

The Cape Breton, which was in collision with the Richelieu & Ontario Navigation Co.'s steamer Canada, off Sorrel, June 12, has been repaired at Sydney, N. S. A new stem from the forward to the deck line has been built in, and a number of plates had to be taken out and new ones inserted. The steamer has been libelled for $150,000 damages by the R. & O. Co.

The steamer Joe Milton, built at Port Stanley, Ont., in 1891, and latterly in the coasting and fish carrying trade between Manitoulin island and Owen sound for the Wolverine Fish Co., was burned to the water's edge at Papoose island June 19, the crew being saved and landed at Owen sound on the following day.

The Lake Ontario Navigation Co. has been organized to operate the steamer Argyle between Toronto and other ports on the north shore of Lake Ontario. Judge Morson is president of the company and Capt. O'Brien is master; Capt. Sullivan, first officer; J. W. Hazlett, purser; J. Hazlett, chief engineer; and W. Owens, steward of the steamer.

The department of public works has approved of the tender of P. Lyall & Sons for the fourteen steel sheds at Montreal, and the government has passed an order in council exempting the steel for the same, which is to be imported from the United States, from the new tariff on steel. The order having been placed before the increase in the duty.

The Dominion government is holding an investigation at Montreal into the loss of the Richelieu and Ontario Navigation Co.'s steamer Canada, after collision with the Dominion Coal Co.'s steamer, Cape Breton, off Sorel, June 12. The Cape Breton had nine plates damaged by the impact. The body of an additional victim has been discovered making the loss of life six.

The Lake of the Woods system of navigation is an international one, as it borders on the state of Minnesota for some distance. On the United States side the government is doing considerable dredging at War-road, and the War-road Transportation Co. is having a new steamer built for the trade. In Canada the department of public works recently had an engineer going over the Rainy river, which connects the Lake of the Woods and Rainy lake, forming the international boundary, to see what it is necessary to do to improve the navigation along it.

J. J. Long, formerly president of the Northern Navigation Co., president of the Collingwood Ship Building Co., of the company owning the Collingwood dry dock, and interested in a number of other industrial and financial concerns, left the house of his brother, T. Long, Jarves street, Toronto, July 2, and his dead body was found floating in the Don river July 5. For some time past he had not been at all well and recently returned from a European trip which his friends say did not benefit him any. The late Mr. Long was 61 years of age and was a native of Limerick, Ireland.

The steamer Mary Hough, recently brought out from Liverpool, Eng., by Bowring Bros., Ltd., St. Johns, N. F., for the West coast run, ran on the rocks and has become a total loss. The steamer Restigouche, owned by the North American Transportation Co., has been chartered for the service. A new steamer—the Portia—has been launched at Port Glasgow, Scotland, to be placed in the service permanently, and a second steamer is under construction at the same port for the east coast service, which Bowring Bros. are under contract with the Newfoundland government to provide.

The electrical device which has been laid down in the St. Lawrence river for a distance of about two miles near Sorrel, Que., for the guidance of steamers in the channel, has been completed, and the tests were commenced on Monday. The promoter of the system is Louis Herdt, and the apparatus consists of an electric cable in the channel, with which the vessels passing up and down the river will be continuously in touch, the breaking of the current will indicate to the officers that there has been a deviation from the route. The affair is only in the experimental stage, and complete details are unobtainable. The result of the experiments which are now in progress will be watched with interest.

DEVOTED TO EVERYTHING AND EVERY INTEREST CONNECTED OR ASSOCIATED WITH MARINE MATTERS ON THE FACE OF THE EARTH.

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So far over twenty states have expressed their sentiment in favor of extending federal assistance to the American merchant marine, which has been declining for several years. Nearly all of these platforms refrain from any specific form of aid, being desirous that the remedy should be worked out by congress itself. They therefore merely declare in favor of the general principle of aid, and leave the details to those who have made a special investigation of the subject. This is entirely in accordance with the general plan of the Merchant Marine Commission, which is now, under congressional authority, making an inquiry into the state of American shipping in the foreign trade. The plank adopted by the Republican national convention is a strong declaration in favor of giving assistance to the American merchant marine, but, in conformity with the general plan, leaves the precise form of action to be taken absolutely in the hands of congress. This seems, indeed, the common sense thing to do. The country will doubtless be better informed on the shipping question when this commission finishes its investigation than it is now. The commission is collecting a great mass of data, which will be carefully digested and set before the country in such a way as to conduce to a general study of the subject.

A striking example of present conditions in the American merchant marine trade is afforded in the forced sale of the steamships Minnetonka and Minnewaska which is to be held at the offices of the Citizens Savings & Trust Co., Cleveland, on July 30. These two vessels are the first vessels exceeding Canadian canal dimensions that have been built on the great lakes for over-sea trade. They were constructed by the American Ship Building Co. at Cleveland in 1902, were cut into two sections, towed through the canals to Quebec and there put together. They were built under the supervision of Lloyds and were uncommonly well constructed. The company owning them is known as the American Navigation Co. and is largely made up of financial interests along the great lakes. Both of these steamers left Quebec in the late fall of 1902 and their initial trips were to London. The Minnewaska then went to Tampico, Mexico, and from there to New York. Subsequently she made a coasting trip from New York to San Francisco and back and was then placed in ordinary. The Minnetonka returned to Boston from London and made one coasting trip to San Francisco. She then went to Tacoma, Wash., and from there returned to New York and was then placed in ordinary. This was the full extent of their actual work. They could get no cargoes and have been lying in idleness at Brooklyn for the past six months. Meanwhile the foreign trade of the United States has been growing by leaps and bounds until it has now reached the enormous total of $2,500,000,000, and yet in spite of this these magnificent steamships, flying the American flag, can find absolutely nothing to do.

However, the fate of the Minnetonka and the Minnewaska is not all. Four years ago, when it seemed as though congress would remove the handicap which exists in American shipping in the foreign trade, other orders were placed for ships for this service. These orders were placed by the Atlantic Transport Co. and the Boston Steamship Co. and the work was apportioned to the New York Ship Building Co. and the Maryland Steel Co. Subsequently the Atlantic Transport Co. disposed of two of its steamships to the Pacific Mail Steamship Co. and the vessels were rechristened Manchuria and Mongolia. The other vessels placed at this time were the Missouri, Maine, Mississippi and Massachusetts. Of these fine steamships the Maine is the only one which is now in actual commission. The others are lying in idleness in various parts of the world. About this time also Mr. J. J. Hill of the Great Northern railway placed orders for two steamships, the Minnesota and Dakota. These steamships are about to go into commission, but Mr. Hill has already announced that he would rather build a thousand miles of railway than construct another ship like them.

Meanwhile the great export trade of the United States is enriching the foreign ship owner. It is not to be supposed that the American ship builder cannot build ships as good as his foreign rival; it is not

to be supposed that the American sailor cannot man them as well. The time is not long past when the American ship builder led the world in the construction of ships. Nothing to equal the grace and speed of the clipper ship as a sailing ship has ever appeared on any ocean. At that time the opportunity was afforded to the American ship builder to build them and the American sailor to sail them and it was triumphantly seized upon. Granted an equal chance now it will be seized upon again. But with higher cost of construction, higher cost of operation, higher wages and a better food scale it is impossible for the American ship to compete with the cheaper constructed and cheaper run rival. This condition is the direct result of the protective policy which has been extended to every industry except shipping. Something should be done to equalize the condition which has been bred by this purely American policy. The difference should be made up. The Merchant Marine Commission which is now touring the country has been well received in all the cities which it has visited and a great mass of data has been submitted to it to be digested. Out of it all something tangible ought to come for the benefit of American shipping and it is quite clear that a sensible measure will be supported by the people in general.

A great deal can be done by the mere reservation of purely American trade to American ships. The customs act has been extended to the Panama canal zone by which all goods going to the zone from foreign countries must pay the same tariff that they would have to pay to be admitted into the United States. This is virtually a recognition that the zone is American territory. If it can be declared to be a part of the coasting trade then the enormous supplies which will be consumed during the ten years that the canal is building will be transported to the zone by American ships. There need be no fear that excessive freight rates will be charged because it would be competitive trade anyhow, the competition being confined to American citizens. Such a condition exists on the great lakes where the trade is exclusively confined to American ships and where the competition between American citizens for it is so active that the freight rate is the lowest known anywhere in the world.

FREIGHT SITUATION ON THE LAKES.

The freight situation from the vessel owner's standpoint does not show any present sign of improvement. Mr. Harry Coulby, president and general manager of the Pittsburg Steamship Co., chartered tonnage this week upon a basis of 70 cents from the head of the lakes but the total amount was not made known. It does not, however, reach the total chartered last year. Owing to the fact that vessels were more numerous in early cargoes the Escanaba rate fell from 55 to 50 cents last week and there is a disposition in some quarters to establish the Escanaba rate at 60 cents. The present rate from that port is 55 cents and it is maintained that a differential of 5 cents between that port and the head of the lakes more nearly represents the actual difference in cost than the 10 cent differential which was obtained in former years. However there has been talk of making the differential 10 cents this year again. It is the old story of supply and demand and there appears to be no gainsaying the fact that for the business now offering there are more vessels than cargoes. The quarterly statement of the Steel Corporation, however, shows a marked improvement in profits over the preceding quarter which, of course, means an added consumption of the products of iron ore; building operations, involving structural steel, are reported to be considerably on the increase, and the action of the Democratic national convention has resolved the forthcoming presidential campaign into a thoroughly conservative affair, not in any degree threatening the ordinary conduct of business, so that a general improvement in industrial conditions may be looked forward to from now on. Vesselmen are hoping that the fall months may redeem a season that has opened most inauspiciously. Coal is giving quite comfortable employment to a number of carriers but the grain trade has, so far, been a delusion.

CHICAGO GRAIN REPORT.

Chicago, July 13.—The government department of agriculture crop report to July 1 notes favorable comparison with the conditions of last year and figures of same are generally suggested as follows:

	Crop of 1904.		Crop of 1903.
Wheat	635,000,000	Bus.	638,000,000
Corn	2,385,000,000	Bus.	2,240,000,000
Oats	818,000,000	Bus.	780,000,000
Barley	130,000,000	Bus.	131,000,000

Moderate cash selling of the past week with steady vessel offerings, more noticeable however those of lake and rail interests, continues the freight basis at ¾c Buffalo corn. The export situation is dull and unchanged, and rates all water routing to Montreal nominally 3½c corn.

Recent activity at other down shipping points practically removes whatever pressure of outside vessels and, east bound package trade working stronger, rates may be restored to 1c per bushel basis Buffalo at any nearby day.

The week's shipments were distributed about as follows: Via all rail lines: Wheat 120,000 bu., corn 220,000 bu., and oats 650,000 bu. Via lake to Buffalo, etc., wheat 85,000 bu., corn 1,575,000 bu., and oats 70,000 bu. Via lake to Canada ports 200,000 bu. corn.

Following figures cover general shipments and stocks in periods described. Total lake and rail shipping:

	This week.	Last week.	Same week last year.
Wheat	216,258	157,844	655,623
Corn	1,906,802	1,236,281	2,294,195
Oats	744,585	579,638	1,609,397
	2,927,645	1,973,763	4,559,215

	Shipments since Jan. 1, 1904.	Same week last year.
Wheat	6,974,000	11,192,000
Corn	32,036,000	41,864,000
Oats	24,358,000	35,126,000
	63,368,000	88,182,000

Elevator stocks at Chicago and So. Chicago:

	This week.	Last week.	Same week last year.
Wheat	2,285,000	2,563,000	3,065,000
Corn	5,345,000	6,685,000	8,627,000
Oats	1,000,000	1,200,000	1,922,000
Rye	460,000	460,000	322,000
	9,186,000	11,010,000	14,000,000

COMMERCE OF LAKE SUPERIOR.

The report of Sault Ste. Marie commerce kept by the superintendent of the canal shows a greatly reduced movement of freight up to July 1. While last year 11,944,934 tons of freight were moved through the canal up to July 1, the total this year reached only 3,589,124 tons, or a falling off of 8,355,810 tons. The reason for this discrepancy is, of course, well known. Navigation of the great lakes commercially did not begin this year until June 15, owing to the strike of the Masters and Pilots' association. The movement to July 1 is, therefore, to be regarded as two weeks' work, and viewing it in that light it shows the freight movement of the great lakes to be considerable. Following is a summary of Sault Ste. Marie commerce brought up to July 1.

Movement of Principal Items of Freight to and from Lake Superior.

ITEMS.	To July 1, 1904	To July 1, 1903	To July 1, 1902
Coal, anthracite, net tons	219,941	307,863	103,167
Coal, bituminous, net tons	947,946	2,368,855	1,594,859
Iron ore, net tons	1,385,054	7,439,479	7,806,573
Wheat, bushels	11,389,673	21,062,994	24,398,148
Flour, barrels	559,545	2,242,766	2,625,705

Report of Freight and Passenger Traffic to and from Lake Superior, from Opening of Navigation to July 1 of Each Year for Three Years Past.

EAST BOUND.

ITEMS.	To July 1, 1904	To July 1, 1903	To July 1, 1902
Copper, net tons	12,081	32,564	35,614
Grain, other than wheat, bushels	6,093,306	7,680,959	8,710,093
Building stone, net tons	2,850	1,690	17,231
Flour, barrels	559,545	2,242,766	2,625,705
Iron Ore, net tons	1,385,054	7,439,749	7,806,573
Iron, pig, net tons	4,380	1,180	7,396
Lumber, M. ft. B. M	198,567	293,917	329,625
Silver ore, net tons	107		
Wheat, bushels	11,389,673	21,062,944	24,398,148
Unclassified freight, net tons	13,111	25,853	22,325
Passengers, number	2,905	8,431	9,431

WEST BOUND.

Coal, anthracite, net tons	219,941	307,863	103,167
Coal, bituminous, net tons	947,946	2,368,855	1,594,859
Flour, barrels		30	
Grain, bushels	625		60
Manufactured iron, net tons	26,382	42,812	42,854
Salt, barrels	84,931	145,287	174,274
Unclassified freight, net tons	112,378	161,708	190,796
Passengers, number	2,701	8,444	10,436

Summary of Total Freight Movement in Tons.

	To July 1, 1904	To July 1, 1903	To July 1, 1902
East bound freight of all kinds, net tons	2,269,847	9,043,078	9,529,439
West bound freight of all kinds, net tons	1,319,277	2,901,856	1,957,062
Total freight, net tons	3,589,124	11,944,934	11,486,501

Total number of vessel passages to July 1, 1904, was 2,689, and the registered tonnage, 2,615,273

MR. ROBERT LOGAN ON THE TURBINE ENGINE.

Robert Logan, the assistant manager of the American Ship Building Co. returned from Europe last week where he had gone to make a general inquiry into the development of the turbine engine for marine propulsion. Mr. Logan returns with even more profound impressions concerning the turbine than he had before he left though he does not think it has reached such a stage of development as to be seriously considered in the transportation of the commerce of the great lakes. He does not think the turbine in its present state adaptable for the freight steamers of the great lakes. Its economy is greatest when running at high speed and in its present state is exclusively the instrument of the high-speed passenger steamer.

He made some striking observations, however, to the effect that he did not think the present type of reciprocating engine would be considered when the next great passenger steamer for lake service is ordered. He believes the turbine to be eminently adapted for the passenger trade of the great lakes. While the passenger trade of the great lakes is steadily growing, its total tonnage is unimportant when contrasted with the great tonnage employed in the coal, grain and ore trades. However, even the passenger trade is one that must continually grow as population increases and as the great northwest fills up as it is steadily doing. There are now several excellent passenger routes on the great lakes which may be briefly classified as follows: Cleveland to Buffalo; Cleveland to Detroit; Detroit to Buffalo; Detroit to Mackinac islands; Chicago to Mackinac island; Buffalo to Chicago; Buffalo to Duluth and Chicago to Duluth. These runs vary from 125 to 1,000 miles, and all of them enjoy magnificent stretches of open water. If passenger steamers can be placed upon the great lakes whose speed approximates that of the railway no passenger will hesitate for a moment as to which way he will travel. Water transportation even under inferior conditions is delightful, while railway traveling even under the most luxurious conditions is always tedious. What is to be said then of the drawing power for passenger business of a beautiful steamship traveling at railway speed.

Of course, passenger boats are not ordered every day, but Mr. Logan is of opinion that when the next one is ordered the turbine engine will be given full consideration as the motive for its propulsion. He says that the turbine is undoubtedly the engine of the future and that its operation is simply beautiful. Its one great drawback is the fact that it cannot reverse and therefore it must carry an independent engine for going astern. This independent engine is, of course, revolving all the time and expending power for which there is no possible use nine-tenths of the time.

INSPECTING PASSENGER VESSELS ON THE LAKES.

Capt James Stone, supervising inspector of steamboats in the Cleveland district, has, during the past few weeks, made a thorough inspection of all vessels engaged in carrying passengers in his district and finds that every possible precaution for the safety of the public has been taken. During the present week he visited Put-in-Bay and examined all the craft calling at the islands and also engaged in the passenger traffic between the islands and found that masters of the vessels had everything in perfect order. Throughout the country complaint has been made that the lifeboats were fastened with wire and that it would be impossible to launch them in times of panic. Capt. Stone found all the lifeboats on the vessels at the islands fastened with string and that it was the work of but a few seconds to pat them in the water. In point of fact all the passenger lines operating on the Great Lakes have taken the utmost precaution to safeguard the public in every way. The life saving equipment carried by them is all that is required, and fire drills are regularly held. Care is exercised over smokers, and on some of the lines cigarette smoking is absolutely prohibited.

ANNUAL MEETING OF LONGSHOREMEN.

The International Longshoremen, Marine & Transport Workers' association is in convention this week at Milwaukee. The keynote of the address of President D. G. Keefe was in opposition to a sympathetic strike saying: "In making agreements or contracts I would advise the utmost care and deliberation. In fact too much care cannot be exercised. Study every trade thoroughly; understand every line; be sensible of every obligation that you assume in the agreement prior to its ratification. It won't do to play the 'baby act' after the agreement is made by saying that you understood this or that clause to mean something entirely different from that which was originally intended. Having once entered into an agreement we are expected to live up to it like men. No honest man will think for a moment of repudiating his obligations. The word of an honest man is sacred; so also should be our collective work or obligation as represented in the

agreement or contract for our organization." He also urged the formation of a federation of marine craft throughout the entire world. He believed that their interests were interdependent and that the advance of one meant the advance of all. There has been some talk of changing the headquarters of the association from Detroit to Cleveland, but it is not likely that any change will be made.

OPENING OF TRENT HYDRAULIC LIFT LOCK.

The great hydraulic lift lock of the Trent Valley canal at Peterboro, recently described in the Marine Review, was formally handed over by the contractors and opened for traffic on July 9. The town council of Peterboro was the hosts and issued invitations to a large number of distinguished guests. A special train from Ottawa conveyed Hon. H. R. Emmerson, minister of railways and canals; Sir Wm. Neuville, postmaster general; Hon. A. G. Slair, chairman railway commission of Canada; Hon. Jas. Mills, railway commissioner; Sir Sandford Fleming, C. E.; Collingwood Schreiber, deputy minister of railways and canals, and a large delegation of officials, members of the house of commons and others. Among others present were Hon. F. R. Latchford, minister of public works for Ontario; Hon. J. R. Stratton, M. P. P., Peterboro; W. T. Jennings, C. E., and C. H. Rust, C. E.

The visitors were entertained to lunch at Lock 5 and then proceeded down the canal four miles on two steamers to the new lock and locked through, everything working to perfection. The lock was then declared open by Hon. H. R. Emmerson dedicated to the trade and commerce of Canada. A number of congratulatory speeches were made and the members of the government declared themselves to be in favor of completing the canal through from Georgian Bay to Lake Ontario. The visitors were then taken for a sail down the valley of the river Otonabee, which forms part of the Trent waterway. By the opening of this lock 150 continuous miles of the Trent Valley canal is now open for traffic, 100 miles north and 50 miles south of Peterboro. The event created much enthusiasm, and the lock and its mechanism, the largest of its class in the world and the only one in America, called forth expressions of great satisfaction from the public men and engineers who were present. It reflects great credit on S. B. Rogers, C. E., superintendent of the canal, and W. J. Francis, C. E., engineers of the hydraulic lock. The lock has been eight years under construction and cost about $700,000. The time occupied in lowering the first steamer that went through at the opening ceremonies, from the upper to the lower level, a distance of 65 feet, was between four and five minutes, which will be reduced to three minutes when all the working smoothly and the lock hands become accustomed to their duties.

SHIPPING IRON ORE TO GREAT BRITAIN.

The recent exports of iron ore from this country to Great Britain and Europe have attracted much attention. Only on rare occasions has the attempt been made to ship so bulky a commodity as iron ore abroad. Within the past month, however, 20,000 tons have been shipped to Glasgow and Antwerp and 100,000 tons more have been booked. This ore is being handled by Witherbee, Sherman & Co. of New York and is the first foreign shipment of ore that concern has made in ten years. Owing to the high freights it has been impracticable to ship to the other side, but it is understood that by a recent arrangement the company has been able to place ore in the foreign market at practically the same rate as grain freights to the coast. The ore is from the Lake Champlain district, which, while not as good an ore nor as cheaply produced as the Lake Superior product, has the advantage of cheap transportation to the coast. It goes from Lake Champlain by canal to New York. In the light of the fact that furnaces are banking in this country the fact that ore should be shipped abroad is quite interesting.

OBITUARY.

Capt. Peter Anderson, one of the best known captains on the lakes, died on July 4 at his home in Milwaukee. He was 58 years old.

Capt. John O. Lindquist died at Marinette, Wis., recently. He was well known on the lakes and has been connected with the Lindquist Fish Co.

Capt. Frank W. Stenton was taken off the steamer Princeton at Sault Ste. Marie last week and removed to the marine hospital. He died in the hospital a few hours later from heart failure. Capt. Stenton who lived at 71 Bridge street, Cleveland, was one of the best known masters on the lakes and his loss is greatly deplored.

Capt. Wyckliffe J. Bohannon, the senior captain of the fleet of bay steamers of the Baltimore Steam Packet Co., died July 3 at the Maryland University hospital at Baltimore. He had been in the service of this company for the last thirty-three years. The last vessel he commanded was the Alabama, having been her master since she was put into commission in 1803.

The death of Mr. John J. Long, president of the Collingwood Ship Building Co., will be deeply regretted in industrial circles generally. The circumstances of his death are unknown, his body having been found in the river Don east of Toronto last week. His health for some time had been far from good and he had been a great sufferer from sleeplessness. He returned from England only three weeks ago and his condition at that time was noted to be extremely nervous as a result of excessively close application to business. He was a very hard worker and his business interests were wide and important. Besides being president of the Collingwood Ship Building Co., he was a member of the firm of Long Bros., Collingwood, vice president of the Collingwood Meat Co., vice president of the Anglo-American Fire Insurance Co., director of the Bank of Toronto, director of the Northern Navigation Co. and various other companies. He was born in Limerick, Ireland, in 1843.

WITH THE LAUNCH BUILDERS.

The Racine Boat Mfg. Co., Muskegon, Mich., has sold a high speed racing launch to F. A. Glascoe of Buffalo, N. Y. The launch is 35 ft. over all, 4 ft. 9 in. beam and is of quite substantial construction. The motor is of a four-cylinder, four-cycle type, developing 40 H. P. at 800 revolutions and was built by the Racine Boat Mfg. Co.

The Auto Boat Mfg. Co. of West Mystic, Conn., has sold the high speed racing launch Scoot to W. D. Bishop, Bridgeport, Conn. The Scoot is 30 ft. over all, 28 ft. 6 in. water line 4 ft. 4 in. extreme beam and is equipped with 16 H. P. four-cycle four-cylinder Hasbrouck motor.

E. D. Jackson, Oshkosh, Wis., has planned to visit the World's Fair in his 47-ft. cabin launch. The launch was built by Jones & La Borde, Oshkosh, Wis., and is fitted with a Murray & Tregurtha engine. Mr. Jackson will go through the drainage canal to the Mississippi river.

The Oshkosh Boat Works, Oshkosh, Wis., has recently filled an order for row boats for the Park system of Chicago. The order was a big one and it took four cars to transport them.

Jones & La Borde, Oshkosh, Wis., are building a 38 footer and a 30-footer for a syndicate representing the White Bear Lake Yacht Club for a contest for the Canadian cup. This company is also building a 51-ft. cabin boat for W. O. Jones of Chicago. She is to be fitted with a 25 H. P. engine, built by the Marine Iron Works, Chicago, Ill.

GRAIN SITUATION AT DULUTH.

Duluth, July 15.—Freights to Buffalo on grain are down to 1c. a bushel, and very dull and slow at that. There is absolutely no life to the market, and the line boats, which have brought rates to the present ebb, are taking all stuff offered. Some flax has been chartered this week and a little wheat. There are only about 1,100,000 bu. wheat in store at the head of the lakes, all grades, and of coarse grains there is but 230,000 bus., all varieties. Flax is in greater quantity, but most of what is here will not be moved in any event.

Delays in unloading coal cargoes have been numerous, for there has not been room at docks for all the ships that have been arriving lately. With freights low as they are shipowners cannot be blamed for complaining at poor dispatch in port.

Crop reports from the American northwest and Canada continue coming with unfailing regularity almost as rose colored as ever, and there are few pessimistic farmers in that region. The plant is growing finely, as all say who have been in the northwest, and specimens of wheat coming in are excellent. Of course the crop is late, but it has been coming along well, and while straw is very heavy the indications are for a large berry. Canadian reports are also good, but the lateness of the crop is worse there than on the American side, and some predict a loss by frost, providing there is the usual fall weather. In the meantime preparations to handle an immense tonnage of grain are under way by the roads, on both sides the line.

Flax receipts at Duluth are only 700,000 bu. less than for the entire crop year of 1902-3, and only 400,000 bu. under a year ago to this date. Flax is coming here in considerable volume and the shortage will be well made up shortly.

WITH THE LAKE SUPERIOR MINES.

Duluth, July 13.—At Stevenson mine, Mesabi range, the Drake & Stratton Co. is stripping with three shovels, the mining company is mining with three more and exploring the ore body with several churn drills. The mine has been very much bothered this spring for want of sufficient cars to handle its product and has not shipped an average of more than 7,000 tons a day, but on Sunday last there were plenty of cars and the three shovels in ore double shift, loaded 560 cars, or 17,000 gross tons. This was the mine's best record, and shows the possibilities of an open pit property, even though not arranged to the best advantage for handling cars and loads. The stripping shovels are working a cut along the north side of the pit and when they are through there will be an exposed ore body 500 feet by 4,000, and of varying depths. It has been found that some ore exists to the south of the stripping and drills are now examining its quantity and quality.

It is stated that there are about 600 more miners employed at Ironwood and its immediate vicinity than two weeks ago. The mines have all taken on additional men and have reopened parts long idle. They are loading their stocks as fast as weather permits.

Mining has been resumed at the old Richmond, A. Maitland, lessee, located on the Cascade range, and it will be a shipper of a considerable quantity of ore this year. This produces a lean silicon bessemer useful for flux with low silicon ores. Other properties in the same region are to reopen later.

At Volunteer the Northwestern road is putting down several tracks to stockpiles, and the mine will ship at least 50,000 tons from the 200,000-ton pile accumulated during the operations of the Donora Mining Co. and later. It is not probable that the mine itself will be reopened this year.

At Breen mine near Waucedah, Menominee range, active exploration will be undertaken soon. This property is in the hands of members of the Pewabic Mining Co. Diamond drills will be employed to test the formation.

Bristol mine, Menominee range, has let out a number of its men and has almost wholly suspended mining operations. While it is idle the shaft will be sunk another level in the hope of getting into better ore. On the other hand Florence mine, that has been idle, has resumed with a full force.

AROUND THE GREAT LAKES.

The maiden cargo of coal of the steamer Sahara was 8,906 tons, 200 lbs. The maiden cargo of ore was 8,140 tons.

A brief strike occurred on the Duluth, Mesabi & Northern docks this week, but it was settled by giving the men an advance of 10 cents per day.

The passenger steamer Island Belle was caught in a furious gale on the St. Lawrence river this week and the hurricane deck was lifted off its supports. No one was injured.

The ice crusher Ste. Marie is undergoing extensive repairs at the yard of the Detroit Ship Building Co. She was considerably battered in her encounter with the ice last winter.

The M. Rabbitt & Sons Co., Toledo, has chartered the tug Hallister of the Sullivan Line for an indefinite period. The company will use the tug on the St. Clair Flat ship canal.

Andrew McGilvray, chief engineer of the Steel Corporation steamer W. J. Gilbert was killed last week by the blowing out of a cylinder head of the engine on the towing machine Carington. He was forty-five years old.

The steamer S. C. Baldwin, sunk by ice last fall near Long Tail Point, Green Bay, is being repaired at Sturgeon Bay. She is to be converted into a tow barge and with a new keel and some planking will make a first-class carrier.

The Western Transit Co. has given contract to the Lake Erie Dredging Co. to deepen Coit's slip at Buffalo. The plans call for a channel 22 ft. deep and when completed the project will be a great benefit to Buffalo shipping.

It is likely that the insurance companies having the cargo insurance of the steamer F. H. Prince, which struck a submerged pier and filled with water at Cleveland some weeks ago, will have a heavy loss. She carried a cargo of rubber goods not more than 15 per cent of which it is estimated is saved.

The lighter Rescue, building for the Great Lakes Towing Co., was launched last week from the Lorain yard of the American Ship Building Co. She possesses certain novelties in construction and is expected to prove a most successful wrecker. She is so designed as to work in the open lake in rough weather, while the Newman is primarily intended for river service.

H. H. Heiner, vice president of the St. Paul & Western Coal Co., announces the acquisition by that company of docks at Milwaukee and Green Bay, Wis., which will give it facilities for handling and shipping a large tonnage of Sunday Creek Hocking coal. The company now has, including its docks at Superior and Duluth, an annual storage and shipping capacity of 2,000,000 tons of bituminous coal.

Capt. Knowlton and Chief Officer Milne, accompanied by a crew of ten men, are now on their way to England from Toronto to bring back the government steamer Canada, recently launched at the ship yard of the Vickers & Maxim company at Barrow-in-Furness. The Canada will be used for the protection of Canadian fishing grounds on Lake Erie from the invasion of American fishing boats.

Robert Dollar, head of the Dollar Steamship Co. of San Francisco, Cal., has let a contract in England for the construction of a 7,000-ton freight steamer, to be used in the trade between San Francisco and the Orient. The new vessel will be about 400 ft. long, beam 52 ft. and depth 26 ft. It will be ready for launching in about seven months.

ITEMS OF GENERAL INTEREST.

The armoured cruiser South Dakota will be launched from the yard of the Union Iron Works, San Francisco, July 23.

The first war vessel constructed at Manila, P. I., was launched there on June 29. She is named the Woodruff and is a gunboat.

Charles Dana Gibson of New York is having a 20-ft. launch built at Camden, Me., by A. Barrett's Son. The boat is to be equipped with a 4 H. P. Cushman motor.

The cost of repairs to the Pacific Mail liner Algoa, which recently grounded at the entrance to San Francisco harbor, is estimated at between $75,000 and $100,000.

The Lake Superior Contracting Co. started on July 11 to raise the dredge Port Huron, which recently sank in the rapids below Fort Gratiot light at Port Huron.

A. D. Story of Essex has contracted to build a new vessel for the American Maritime Co. of Boston. He will also build a 60-ton craft for the Mobile Fish Co. of Mobile, Ala.

The official trial of the Bennedetto Brin equipped with Belleville boilers was most successful. The trial board declared itself very well pleased with the working of the apparatus.

The steel tug Charles F. Dunbar, formerly owned by the Great Lakes Towing Co. and stationed at Buffalo, left Ogdensburg on July 6, for Boston. She will tow mud scows in Boston harbor.

Swasey, Raymond & Page have received an order for a 25-ft. open launch for Stephen Powers of New York city. The boat will be built of cedar and will be 5 ft. 6 in. beam. She will have a 10½ H. P. Buffalo engine.

A new steam schooner building at Bendixsen's yard at Eureka, Cal., for the Dollar Steamship Co., will be launched in about a month. She will be named the Harold Dollar, and will have a capacity for 900,000 ft. of lumber.

Burger Bros. of Manitowoc, Wis., have a number of launches under way. They have recently delivered a 55-ft. cabin launch to Fred Busse, Springfield, Ill., and have just shipped a 45-ft. cabin launch to Fred Hopp, Kenosha, Wis.

The Standard Contracting Co. has started raising the machinery from the tug Cascade, which sank east of the harbor entrance at Lorain last winter. The company purchased the wreck of the tug for $2,000 and will use the machinery for a new tug.

Johnson & Stanton, divers, have taken the boiler, anchor and anchor chains from the sunken Quito at Lorain. The remainder of the wreck will be given to the divers in part payment of their work. They expect to raise the small engines on the boat.

The Western Maryland railroad has asked the ship builders of Baltimore to bid on the construction of two coast schooners and four barges to be built for that company within the next four months. They are to be used in carrying coal from Baltimore to New York and New England ports.

The actual time made by the Smith & Mabley automobile boat Challenger as recorded by the Motor Boat committee of the Automobile Club of America in the trials held last week show the average speed to have been 26.5 miles per hour over a course of four turns, the time required for the turns being deducted.

Arrangements have been completed for the construction of the Newport News Coal Corporation's big coal pier, to be located just south of the Chesapeake & Ohio pier 10 at Newport News. The new pier will be 160 ft. wide and 700 ft. long and will be equipped for handling a large tonnage at a minimum cost.

The committee on rivers and harbors headed by Hon. T. E. Burton of Cleveland will visit Boston early in August and make a careful examination of the harbor to ascertain what improvements are necessary to establish deep draught in the harbor. The program of improvements outlined by the Boston Chamber of Commerce contemplates an expenditure of $1,000,000.

As a result of information received by Edward B. Hebert, chairman of the Canal Association of Greater New York, it is expected that the ceremonies to mark the beginning of work on the new Erie canal will be set for Aug. 15. The information is from Edward A. Bond, chairman of the advisory board of engineers.

Bids will be opened by the bureau of yards and docks, navy department, on Aug. 27 for the construction of a dry dock to the New York navy yard. Bids were opened in January last but were in excess of the money available and were rejected. Plans have been somewhat altered, but the size of the dock will remain the same as before.

The John Stuart Co., Wollaston, Mass., has under construction a 45-ft. cabin launch with white oak frame and timbers and white cedar planking. The deck and deck-house cabins and staterooms are finished in mahogany. The company is also building two 25-ft. auto boats and has under construction one 20-ft. launch and one 36-ft. launch. The company is also building a 40-ft. auto boat for Mayor Bryant of Quincy, Mass. She is to have a high speed gasoline engine of sufficient power to drive her about 25 miles an hour.

During the year 1903 the total number of British ships that entered the port of Philadelphia was 656, with a tonnage of 1,394,203 net tons, showing an increase against 1902 of thirteen vessels and 41,061 tons. The increase in cargo carried by British shipping amounted to 117,638 tons, direct from the United Kingdom and her colonies. This, taken by itself, would apparently show a large increase in British exports to the United States, but when one takes the total direct imports from the British empire in all bottoms—foreign as well as British—there appears an actual decrease of about seventeen ships.

In the builder's trial trip recently the United States armored cruiser Colorado attained a maximum speed over her course of 22.31 knots an hour, the average of two runs under forced draft being at the rate of 22.10 knots an hour. The cruiser was launched over a year ago and no attempt was made to scrape her bottom which was consequently foul. The coal was the ordinary run of mine and the course was comparatively shallow, so that her speed is very good indeed, and it is expected that she will do considerably better on the official trial trip. The Cramp's are very well pleased with the performance of the Colorado.

The Booth Steamship Co. will shortly make a change in their service to Iquitos, Peru. The freight will be shipped from New York instead of being handled via Liverpool, on steamers for Manaos, Brazil, and from there will go by barges up the Amazon river to Iquitos. This will give shippers a twice a month service instead of once a month as is the case when the freight is shipped by way of Liverpool. Iquitos is the furthest point inland in the world which may be reached by ocean-going vessels, being 2,800 miles distant from the Atlantic on the Amazon river. Steamers drawing 15 ft. can reach there any season of the year. The Amazon is navigable for light draught steamers to a point 3,360 miles distant from the ocean.

While the returns for the past six months show that little has been done to remove from the ship building industry of Britain the depression which threatens it when the year began, it has been better in some ways than was anticipated. Something like 262,000 tons of new work is reported as placed as compared with 202,000 tons in the first of last year. The half year output aggregates 160 vessels of 201,633 tons as compared with 130 vessels of 208,441 tons for the corresponding six months of the previous year. The half year, therefore, judging by figures only, would seem to have held its own very well, but in order to make up for the months of last year in which contracts were few and far between much more new work than has been booked recently is required.

STEAM TURBINE PROPULSION FOR MARINE PURPOSES.*

By Prof. A. Rateau of Paris.

There is no need, in a country which has given birth to the Parsons turbine, to insist upon the interest attached to the application of the steam turbine to the propulsion of ships. The remarkable results which the distinguished inventor of that engine has obtained are matters of common knowledge, and the author is one of those who have most admired and appreciated the methodical manner in which these results have been achieved. This important question has also attracted much attention in France for several years past, and I propose, therefore, to give the results which have so far been attained there. If these results are but slender, it is due to the fact that the means at our disposal have not been sufficient to enable more progress to be made.

There are, at the present time, two ships fitted with our turbines, namely, the French torpedo boat No. 243, and a first-class torpedo boat built by Messrs. Yarrow & Co. The latter alone has been constructed according to our ideas, as the restrictions imposed by the naval authorities upon the French torpedo boat, and the conditions laid down for its propellers have created such difficulties that it has been impossible up to now to obtain a satisfactory speed with this vessel. It was, however, only a trial boat, and the speed was not required to exceed 20 knots; in point of fact, we have obtained over 21 knots. With Messrs. Yarrow & Co.'s boat, on the other hand, the conditions are such as to utilize the full value of the turbines, and the latter have been further supplemented by a small reciprocating engine for economical working at reduced speeds. The trials with this boat are, therefore, of considerable practical interest, and I have much pleasure in acknowledging our debt to Mr. Yarrow for the breadth of view which he has shown in dealing with these new conditions.

Another small vessel, the Libellule, was to have been fitted with a turbine of our manufacture, and the engine has been completed for some time past, but the trials have not yet taken place, as the special boiler with which it was desired to make the experiments was not ready.

Before going into the details of each of these applications of our system of turbine it may be well to set forth some of the obstacles which arise in using turbines for the propulsion of vessels; obstacles which, in the author's opinion, can only be satisfactorily overcome by a joint use of reciprocating engines and steam turbines.

As to the advantages of turbines, these are well known: absence of vibration, great reduction of weight, ease in handling, absence of wear and tear, etc. There is no need further to insist upon them.

The three principal difficulties in applying turbines to the propulsion of ships are as follows:

(1) Design and arrangement of propellers for a high speed of rotation.

(2) Efficiency of turbines at low speeds.

(3) Reversing and maneuvering powers.

ARRANGEMENTS FOR PROPELLERS FOR A HIGH SPEED OF ROTATION.

When the turbines are not restricted to any particular speed of rotation, a very high efficiency can be obtained, certainly higher than that of the best reciprocating engines. The author's experiments confirm this fact, which had already been shown by the published trials of the Parsons turbine. Unfortunately, the best speed for turbines is usually much too great for screw propellers. In high speed vessels, by some give and take between engine and propeller, a working agreement can be arrived at; but it is not easy to do. The gearing of the rings has to be higher than with a turbine for other purposes, and the turbine itself must be divided up into several sections in series, and further, it is necessary to devise some arrangement for the propellers by grouping them either singly, in pairs, or in threes, on several shafts, and to so increase their surfaces that the extreme outside diameter shall be greater than the pitch—all of which tends to reduce the total efficiency of the engine and propellers.

If, therefore, the turbine is theoretically superior to the reciprocating engine as regards consumption of steam at full speed, it is not by any means certain *a priori* that the joint efficiency of both engine and propeller is better or even as good.

The practical difficulties, moreover, increase as the speed diminishes, for in the first place the total surface (and con-

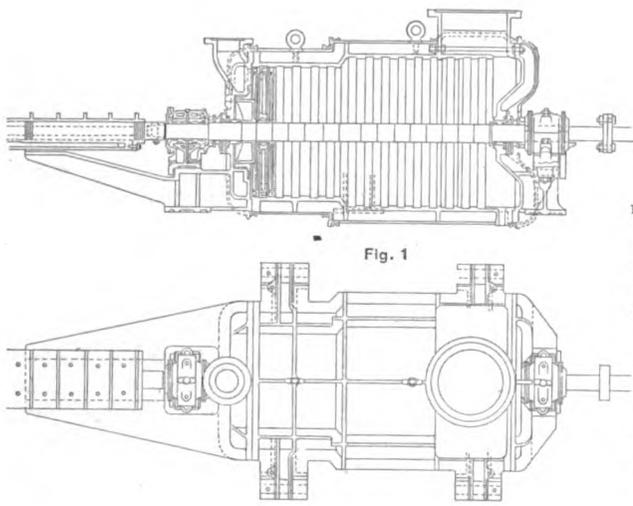
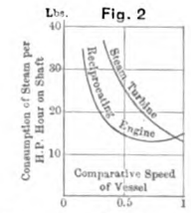
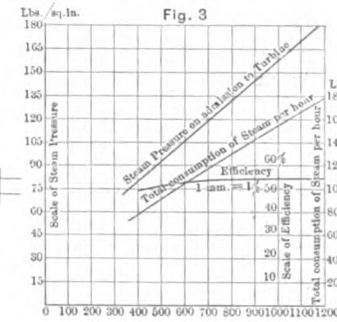
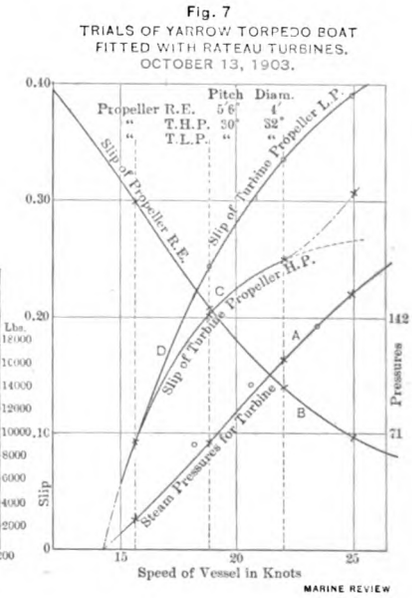


Fig. 1







RATEAU STEAM TURBINE.

*Paper prepared for Institution of Naval Architects.

sequently the size of the propellers) is mainly determined by the principal cross-section of the ship, whereas, on the other hand, the size of the turbines is limited only by the speed of rotation, and not by the power developed. The speed of the turbine must be reduced in proportion to the speed of the ship, so that the dimensions of the former are increased, either by the number or the diameter of the moving rings, whilst the power diminishes approximately as the inverse of the cube of the speed. There is, therefore, a lower limit of speed, below which the use of turbines cannot be recommended. The author has already expressed the opinion that this limit is in the neighborhood of 20 knots. The author is aware that certain ships now under construction for transatlantic service, and of a proposed speed of 17 knots, are being fitted with turbine engines, but the future will show how these will turn out.

EFFICIENCY AT LOW SPEED.

If the steam turbine is capable of giving good results at the maximum power, it cannot be gainsaid that the results are certainly unsatisfactory at reduced speeds, not so much on account of the reduction of power, as on account of the reduction in the speed of rotation, which involves a lowering of what is termed the "hydraulic efficiency" of the turbine. The curves in Fig. 2 show the general behavior of the steam consumption per horse power of a turbine, compared to that of a reciprocating engine, in terms of the speed of the ship, assuming that this consumption is about the same in both cases at the maximum speed. In these approximate curves, it will be seen that at reduced speed the consumption of steam per horse power for the turbine is much higher than for the reciprocating engine. This drawback does not signify in the case of merchant vessels that keep at about their maximum speed. On the other hand, it becomes a serious one for warships that are rarely working at full power. The increase in the coal consumption at speeds of, say, 12 to 15 knots, at which they are usually working, would, however, greatly diminish their radius of action. A partial remedy, as used by Mr Parsons, may be effected by adding a supplementary turbine for cruising purposes, into which the steam first enters when proceeding at low speeds. This, however, does not improve the hydraulic efficiency of the turbine, and the steam consumption nevertheless remains high. The author considers that under no circumstances can turbines alone be economically worked at low speeds, and that the only satisfactory solution is the employment of a reciprocating engine of more or less power, according to circumstances, in conjunction with turbines. With this combination, economical results can be obtained at all speeds, and an example of this will be given later.

REVERSING AND MANEUVERING.

With a reciprocating engine, stopping and reversing are effected in the simplest possible manner, whereas, the very principle of the turbines is essentially opposed to this. Various inventors have tried to solve this problem by means of special blades to enable the same rings to be used for both directions of motion, but these attempts do not appear likely to come to anything, as one can only obtain reversibility by a considerable sacrifice of efficiency in forward motion. It is, therefore, necessary to supplement the turbine by special engines for going astern, and, as it is obviously impossible to have the latter as powerful as the former, one must be satisfied with a very much smaller speed astern than ahead. This difficulty in freely going astern makes maneuvering very awkward. The engine for going astern may be a reciprocating one, which would also be of use for going ahead, but it can just as well be a steam turbine. From the very start, Mr. Parsons used in his vessels special turbines for going astern, and these were attached to the same shafts as the main turbines; but this arrangement has the inconvenience of taking up a good deal of space lengthways.

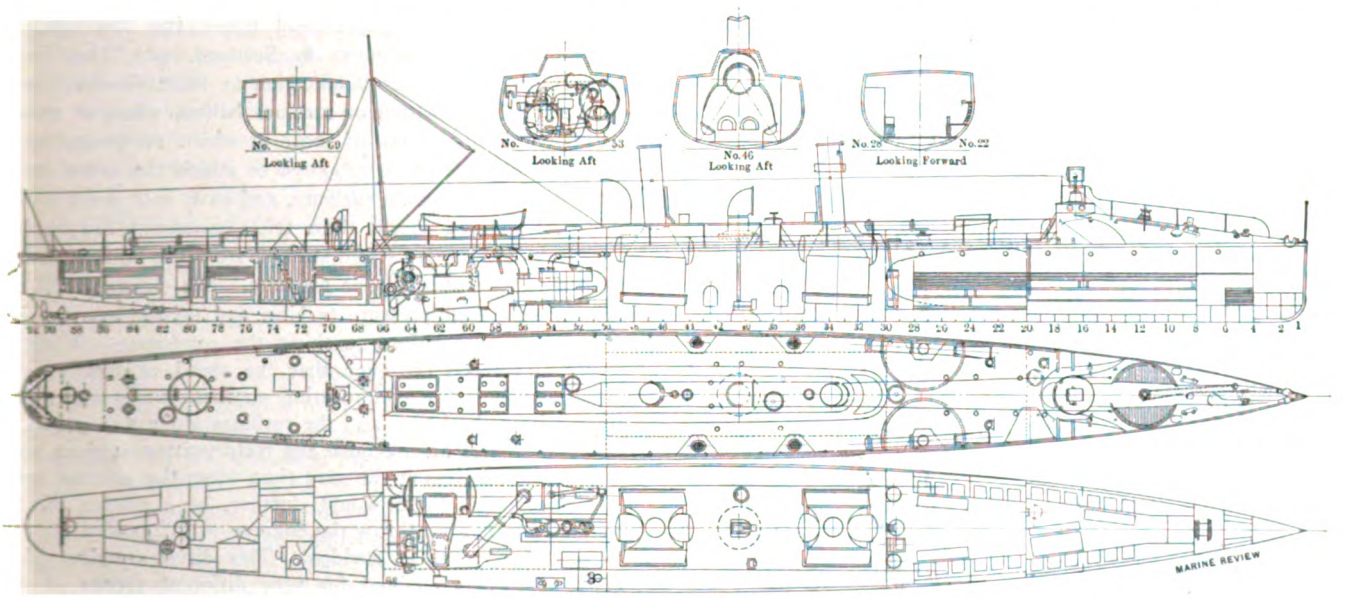


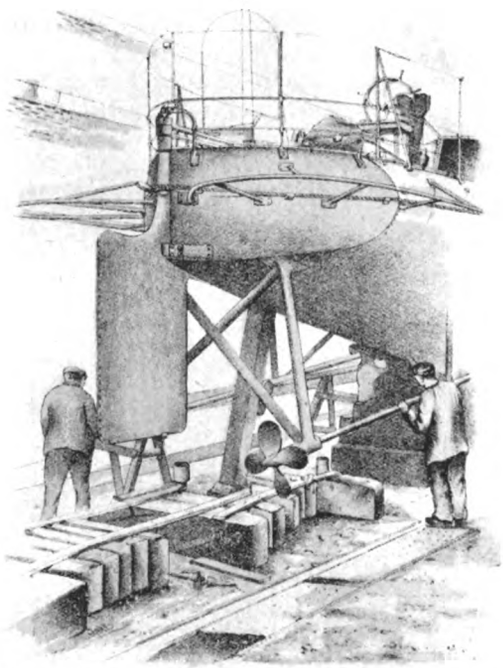
FIG 5. GENERAL ARRANGEMENT OF FIRST-CLASS TORPEDO BOAT WITH COMBINED TURBINE AND RECIPROCATING MACHINERY.

In my patent of 1898 I have indicated how these can be fitted so as to be, as it were, hidden inside the main turbines on the low-pressure side, and without taking up any additional space. When they revolve freely, the astern rings offer no appreciable resistance while the main turbine is at work, and, conversely, the latter is idle when the astern turbine is in motion. This is the arrangement we have got in torpedo boat No. 243 and in the Libellule, and it has the advantage of great simplicity. I think that Mr. Parsons has also made use of a similar arrangement in a certain number of his recent vessels. According as the astern turbine is more or less developed, so the astern speed is more or less increased. With a single live ring, as on torpedo boat No. 243, and for the same expenditure of steam, the astern speed will be about 40 per cent of the speed ahead, but with two rings it can be increased to 50 per cent. Adding more rings, however, adds very little to the speed, unless the number is so greatly increased as to make this engine almost as important as the

principal one. For quickly stopping a vessel, turbines are apt to be inconvenient. After steam is cut off, the propellers continue to revolve by the action of the water, and they usually carry around with them the live rings, for the resistance to rotation is very slight. One can, however, increase this resistance by admitting steam in the opposite direction on the astern rings.

This question of stopping, reversing, and maneuvering is one which, in the author's opinion, may prove a serious hindrance to the extensive use of turbines for ship propulsion. It is particularly important for warships to be able to maneuver with ease, and it will necessarily lead to the adoption of a combined system of turbines and reciprocating engines.

Fig. 4.



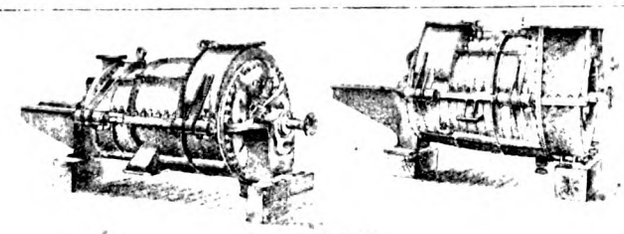


Fig. 6.

RATEAU STEAM TURBINE.

COMBINED USE OF TURBINES AND RECIPROCATING ENGINES.

For the various reasons given above, the best solution appears therefore to be the simultaneous employment of a reciprocating engine and turbines attached to independent shafts, in order that the reciprocating engine may be used at any speed. Each kind of engine is thus adapted to the work which suits it best. The reciprocating engine does for slow speeds, while the turbines come into play progressively as the higher speeds up to the maximum are required. They can, moreover, be equally well arranged for going astern, and the combination of the two then makes maneuvering almost as easy as with ordinary twin screws. An effective horse power astern of 75 per cent, or more, of that when going ahead can thus be obtained.

The power of the reciprocating engine should not be less than one-sixth of the total, and it can quite well be increased to one-third or even to one-half of the maximum horse power. It may be urged that this arrangement is complicated, and that if such an important reciprocating engine is to be retained, it is better to stick to the present system. In reply to this objection, however, the following advantages may be shown:

(1) Reduction of weight, although rather more space is taken up in plan.

(2) Easier working and maintenance, and subsequent saving in personnel.

(3) Reduction of the vibration due to the reciprocating engines.

(4) Increased efficiency, as the turbine is particularly suited to utilize the expansion of steam up to its extreme limit. It may be estimated that the increase in power for the same consumption of steam would amount to 15 to 20 per cent, or, in other words, that 5 or 6 per cent increase of speed would be obtained by the arrangement here proposed.

Moreover, this arrangement will make it possible to bring the turbines advantageously into play at a lower limit of speed. With turbines alone, this limit is about 20 knots, whereas, with the combined system, it is possible to begin at 15 knots, or perhaps even less.

Mr. Parsons, in a paper read before the Institution of Shipbuilders and Engineers in Scotland, on "The Marine Steam Turbine and Its Application to Fast Vessels," spoke of the speed of rotation of turbines falling, when at reduced speed, within the limits of those at which reciprocating engines can work, and he proposed to attach the latter on the same shafts as the main turbines, and have both work side by side. At reduced speeds these triple-expansion reciprocating engines would receive steam straight from the boilers, and expand it to, say, atmospheric pressure. The steam would then pass into the high-pressure turbine, and thence into the low-pressure turbine before reaching the condenser. When the power and speed are such that the speed of rotation rises above the limit for reciprocating engines, the steam will be cut off from the latter, and the turbines alone will propel the ship. With this arrangement the reciprocating engines would therefore be useless at the very time when the greatest power is required, and there would, further, be a chance that the engineers might not throw the engines out of gear at the right time, and so cause an accident. This direct coupling of engines, essentially adapted for very different speeds of rotation, is obviously unsound. The only rational arrangement, in the author's opinion, is to make the reciprocating engine mechanically independent of the turbine, by having it act on a shaft and propeller of its own. But as regards the supply of steam, this can be combined in various ways with that of the turbine, either side by side, as in Messrs. Yarrow's boat, or in series, by having the steam begin on the reciprocating engine and complete its expansion in the turbines. A special combination of this kind, quite different to those already suggested by Mr. Parsons, is what the author advocates.

RESULTS OBTAINED WITH THE RATEAU TURBINE.

Description of the Engine.—The author's design of turbine has already been described in several publications. It need only be stated that it consists of a series of flat moving rings, varying in number according to the requirements, and fitted on a single shaft. These rings are placed between circular discs whose rims fit into grooves on the inside of the casing. The shaft traverses these diaphragms through bushes, which allow but little play. Elsewhere, the clearance between the moving and the fixed parts generally exceeds 3 mm., and can even be as much as 5 or 6 mm. without causing trouble. With this arrangement, and by using the work by "impulse" instead of work by "reaction," we have sought to obtain an engine using as little steam as possible, simple in construction,

needing but little care in working, and capable of running for a long time with but little wear and tear, which, although inevitable, can yet be reduced to a very small amount. The loss of steam is entirely confined to the clearance allowed around the shaft. Moreover, the live rings are so constructed as to be very light, and this is of advantage in reducing the gyroscopic effect which comes into play when the vessel pitches.

Fig. 1 shows a longitudinal section of the Rateau turbine. It is taken from the one installed on Messrs. Yarrow's boat. The figure only shows two rings and one diaphragm, as all the others are similar. In this turbine there are 15 moving rings.

It has been said that with this system, supposing one could reduce the loss of steam to a minimum, it would, on the other hand, greatly decrease the efficiency by the friction between the rings and the steam contained in the chambers in which the rings rotate. As a matter of fact, however, the friction in our engines of 1,000 to 2,000 H. P. amounts to only 2 or 3 per cent of the maximum power—an insignificant proportion—whereas in turbines without diaphragms, the loss by the escape of steam reaches 10, 15, and even 20 per cent of the maximum horse power, directly the clearances increase at all. All the trial results so far obtained show that our system of turbine is extremely economical in steam consumption. Here are a few of the principal results obtained:

Turbines of the Torpedo Boat No. 243.—These were the first multicellular turbines which have been constructed from our designs by Messrs. Sautter-Harlé & Co. in Paris. These turbines were designed some five years ago, and several improvements have been since effected which considerably diminish the consumption of steam.

A turbine exactly similar to the one installed in torpedo boat No. 243 was tried under the direction of the French admiralty engineers in the workshops of Messrs. Sautter-Harlé & Co. This engine was coupled to a three-phase alternator, so as to measure exactly the effective horse power of the turbine. The electric current generated was taken up by liquid resistances. As the losses of energy in the alternator had been measured, it was possible to calculate the net effective horsepower of the turbine, and consequently its efficiency. By the "efficiency" of the turbine is meant the ratio of the effective power which it develops on the shaft to that which the steam consumed is capable of giving, assuming that there is no loss between the pressure at admission and the pressure at exhaust into the condenser. This experiment gave a result higher by 1 per cent than had been originally estimated, viz., 54 per cent instead of 53 per cent, and the results are shown in Fig. 3. The curves there drawn are obtained by reducing the speed of rotation to the uniform speed of 1,700 revolutions per minute, and the condenser vacuum to 26 in. of mercury. It will be seen that at full power, with a steam pressure at admission to the turbine of 145 lbs. per square inch, the consumption per effective horse power on the shaft is 15.2 lbs. At the normal speed of 1,800 revolutions per minute, for which the engine was designed, the efficiency is rather higher, and the steam consumption rather lower. We can now make engines of this power with 60 per cent or even 70 per cent efficiency, according to the speed of rotation which can be used for the turbines, depending on the use for which they are designed.

Turbine of the Yarrow boat.—The turbine for the Yarrow boat has not yet been tested at the works up to its full speed, but from previous calculations it is estimated that the efficiency should be 61 per cent at a maximum of 2,000 H. P., with a normal speed of 1,500 to 1,600 revolutions per minute. The loss due to friction between the rings and the steam is only 41 H. P., or 2 per cent. With 170 lbs. per square inch pressure, and a vacuum of 27 in., the consumption of steam of this engine is $\frac{\quad}{\quad} = 13.4$ lbs. per effective horse power hour, which corresponds to 11.7 lbs. per indicated horse power for a reciprocating engine having 12 per cent loss due to internal friction.

Other turbines.—Other turbines driving alternators, continuous current dynamos, centrifugal pumps or fans, and constructed by Messrs. Sautter-Harlé, have been carefully tested, and, among the results obtained, I would call attention to the following:

An engine of 600 H. P., at 2,400 revolutions per minute, consumes 14.6 lbs. per electrical horse power per hour. The efficiency of the dynamo being 91 per cent, it follows that the consumption of steam for the turbine was 13.3 lbs. per effective horse power hour, or 11.3 per indicated horse power hour, assuming the efficiency of the reciprocating engine to be 85 per cent, the steam pressure at admission being 142 lbs. and the condenser vacuum 26 in.

An engine of 350 H. P. driving an alternator at 3,000 revolutions per minute showed a consumption of 26.2 lbs. per kilowatt generated by the alternator (including exciter), the steam pressure at admission being 152 lbs., and the condenser vacuum only 24 in. The efficiency of the alternator being 87 per cent, this corresponds to a steam consumption of 14.1 lbs. per indicated horse power hour. It will be seen that this was a case of a relatively weak engine working with a very poor condenser vacuum.

A low-pressure turbine of 350 H. P., installed in a mine at Bruay, gave an efficiency rather higher than the above, the total efficiency of the turbine and dynamo combined reaching 58 per cent, or for the turbine alone 63 per cent. Recent tests have shown that the efficiency of this engine has remained the same after a year and a half of continuous work, and no appreciable increase in total steam consumption for the same amount of energy produced has been observed.

A turbine pump of 500 H. P., for raising 950 gallons per minute to a height of over 1,200 ft., and which was recently tested, gave a consumption of 22.5 lbs. per horse power hour in actual water raised, the pressure at admission being 90 lbs. per square inch, and the condenser vacuum 26 in. The efficiency of the pump being 70 per cent, this corresponds to an efficiency of 61 per cent for the turbine. In all the above cases the steam was not superheated.

It will be seen from these examples that even for engines of only 300 to 600 H. P. a working efficiency of over 60 per cent can be obtained, while for engines of 1,000 H. P. and over, it is certain that upwards of 65 per cent efficiency can be realized, as already stated. Hence it is easy to arrive at the consumption of steam per effective horse power under various circumstances, by using the formula which I have already given. For instance, we could guarantee that for an engine of 5,000 to 6,000 H. P., supplied with steam at 150 lbs., and superheated to 350 deg. centigrade, with 28 in. vacuum, the consumption per effective horse power would not exceed 9.6 lbs., which corresponds to 8.6 lbs. per horse power hour, assuming 10 per cent to be lost in internal friction.

In order to properly understand the value of these figures, it is necessary to compare them with those obtained with reciprocating engines. When the expansion of steam in the cylinder has been carried sufficiently far, which occurs at from one-half to two-thirds of full power, the efficiency of powerful reciprocating triple-expansion engines is as much as 62 per cent (this is net efficiency; that is to say, the ratio between the work performed on the shaft and the work that the same amount of steam would give with no loss). But this is not the case when the engines are working at full power, for then, in order not to increase the weights too much, especially on warships, one must increase the admission to the cylinder up to and even beyond 70 per cent. From an investigation made by Mr. Delong, a French admiralty engineer, published in the Transactions of the Association Technique Maritime (1899), the efficiency in work delivered on the pistons of several en-

gines of from 3,600 to 8,400 H. P., varies from 51.7 per cent to 57.8 per cent, or an average of 55.2 per cent (Carnot, Charles-Martel, du Chayla, Galilée, Lavoisier). Deducting therefrom 8 per cent for internal friction losses, this would leave 51 per cent for the net efficiency, whereas, from what has been said above, steam turbines can easily yield over 60 per cent net efficiency when working at full power.

I will now give a few details of the application of these turbines to ship propulsion.*

TORPEDO BOAT NO. 243.

Five years ago, in 1898, the French admiralty began to experiment with steam turbines for the propulsion of warships. Knowing that we had already given attention to this question, the admiralty invited Messrs. Sautter-Harlé and the author to supply engines of this kind for a torpedo boat of 92 tons. The object of the experiment was also to investigate the working of combinations of propellers. In order to reduce expenses, it was laid down that the hull of an ordinary torpedo boat should be used, and that the turbine should be installed in the space usually occupied by the reciprocating engines, in order to allow the latter to be replaced in position if necessary, at the end of the experiment. This arrangement caused a great deal of inconvenience in the installation of the turbines and propellers, and it ultimately resulted in the trial not being so conclusive as it should have been. It was naturally very difficult to adapt turbines to a hull designed for a reciprocating engine, as the cross section of the boat has a distinctly V-shaped outline in its lower part, whereas, for the turbines, which have to be arranged one on each side of the center line, the cross-section should have been much flatter on the floor. Hence the impossibility of sufficiently lowering the main shafts where they enter the turbines, which involved their being very steeply inclined, viz., 11 per cent off the horizontal. Each shaft carried three propellers, and was supported at two points by long brackets fixed to the hull, as shown in Fig. 4.

These conditions were very unfavorable, the steep inclination of the shafts operating against the efficiency of the propeller, and this was fully brought out in the trials; while the excessive length of the brackets aft considerably increased the total resistance of the vessel. As regards the turbines themselves, they have given very satisfactory results, as shown in the reports of the trials. The two turbines, of 900 H. P. (nominal) each, are quite independent of one another. On the exhaust side they enclose a single moving ring for going astern, and in this first attempt, we voluntarily sacrificed power in going astern. The chief object, as has been stated, was to see if the combination of turbines and small propellers could give the vessel anything like the speed she would have obtained with reciprocating engines. In point of fact, 21 knots only was the speed obtained, whereas it should have been 24 knots, as the turbines themselves gave rather more power than had been estimated, and this difference is principally attributable, as already stated, to the steep sloping of the propeller shafts.

At the first trials we had some trouble with oil getting into the condenser. This arose from having designed a joint of oil under pressure at the point where the shaft enters the turbine on the low-pressure side. This joint effectually prevented the ingress of the air, but caused a considerable flow of oil to the condenser. To remedy this we put the low-pressure bearing completely outside the turbine, and used a novel system of stuffing. As to the other bearings, one at the middle of the shaft and the other at the high-pressure end, they both remained inside the turbine. Lubrication was effected by pumping in oil from the outside, and the excess oil afterwards collected.

*There are, at the present time, either in use or in process of construction, over 50 turbines of the Rateau design, with an aggregate of 25,000 H. P., of which 6,200 H.P. are used for ship propulsion, 950 H.P. for turbine pumps, and 760 H.P. for turbine fans.

After the alteration in the low-pressure bearing, the engines worked very satisfactorily, and, although each turbine now has two internal bearings, the leakage of oil to the condenser is very slight, and compares favorably in this respect with a reciprocating engine. Since July, 1902, there have been a large number of trials with this boat in the presence of French admiralty engineers, and no less than six different arrangements of propellers, distributed in pairs or by threes on each shaft, have been tried. The speeds obtained have varied greatly according to the arrangement of the propellers, but at full power, the highest speed varies from 18 to 21 knots, corresponding to a variation of efficiency of 40 per cent. The full details of these trials cannot be given here. I will, however, give the results of two trials made with propellers of 19.7 in. pitch and 23.6 in. diameter in one case, and 23.6 in. pitch and 20.9 in. diameter in the other. The first trials are summarized in table A on the following page.

BOAT BUILT BY MESSRS. YARROW & CO.

Fig. 5 represents the vessel of Messrs. Yarrow & Co., on which the author's system of turbines has been installed. She is a sister ship to the Tarantula, which, as is well known, was fitted with a Parsons turbine, and is similar, apart from the system of propulsion, to the first-class torpedo boats built by this firm for many foreign governments.

Displacement	140 tons.
Length	152 ft. 6 in.
Breadth	15 ft. 3 in.

The boilers, of the well-known Yarrow type, are the same as are usually fitted on first-class torpedo boats, and are capable of giving a maximum speed of from 26 to 27 knots with ordinary reciprocating engines.

The boat here described was fitted with three propeller shafts, actuated simultaneously and separately by turbines and a reciprocating engine; the latter (of 250 H. P.) works the central shaft, and is quite independent of the turbines, receiving steam directly from the boilers, and exhausting directly into the condenser. This central shaft only carries one propeller, which is 4 ft. in diameter.

The side shafts, which are arranged to carry either one or two propellers each, are worked by a turbine in two sections, arranged in series, and rotating in opposite directions. Fig. 1 shows the longitudinal section of the high-pressure turbine, and Fig. 6 gives a perspective view of the two turbines. It will be seen that the supports for the thrust bearings have been increased in order to take the full thrust of the propellers. This thrust being nearly balanced by that of the steam on the drum inside the turbine, it would have been quite possible to reduce the bearings by one-fifth.

The combination of reciprocating engine and turbine as adopted by Mr. Yarrow had already been advocated by Mr. Nabor Soliani, director of the Ansaldo Works, Genoa. But this is not the only possible arrangement, and an even better one, in the author's opinion, is, instead of letting the reciprocating engine exhaust directly into the condenser, to lead the

TABLE A.

TORPEDO BOAT NO. 342. TRIALS OF JAN. 22, 1903.

Six propellers: Diam., 23.6 in.; Pitch, 19.7 in.

Number of trial.	I.	II.	III.	IV.
Speed of vessel (in knots) mean of three runs	17.07	19.59	20.94	21.26
Rotation of turbines -Revs. per minute	1,348	1,572	1,748	1,774
Effective pressure of steam on admission to turbines- lbs. per sq. in.	68.26	100.98	129.42	132.26
Condenser vacuum- inches	28	28	27	27.5
Mean slip of propellers	0.217	0.230	0.260	0.260

With the other arrangement of propellers (23.6 in. pitch and 20.9 in. diameter), the following results were obtained:

TABLE B.

TORPEDO BOAT NO. 243. TRIALS OF DEC. 6, 1902.

Propellers: Diam., 20.9 in.; Pitch, 23.6 in.

Number of trial.	I.	II.	III.	IV.	V
Speed of vessel (in knots)—mean of two runs	14 90	16 59	18 73	18 83	20 89
Rotation of turbines—Revs. per minute	1,051	1,213	1 386	1 392	1,556
Effective pressure of steam on admission to turbines lbs. per sq. inch	55	80	* ?	99 5	115
Condenser vacuum—inches	26 4	26 4	26	26 4	26 8
Mean slip of propellers	0 279	0 304	0 311	0 311	0 316

*Owing to the failure of the gauges, the pressures in the turbines could could not be taken on this trial.

The torpedo boat No. 243 was built by the Société des Forges et Chantiers de la Méditerranée at Havre, where its trials were run

exhaust steam into the low-pressure turbine, or even, under certain circumstances into the high pressure turbine. The author had previously arrived at this conclusion as being the only rational arrangement for economical working at slow speeds. The turbines were built at the Oerlikon works in Switzerland. The total weight of the turbines, which are capable of giving upwards of 2,000 H. P., is 17,200 lbs., or 8.6 lbs. per horsepower, and this could be reduced by diminishing the thickness of the turbine casings which have been made unnecessarily heavy, and by suppressing the supports of the thrust blocks.

At the point where the shafts pass through the ends of the casing, watertightness is obtained by the same system of stuffing that is employed with land turbines. A special regulator governs the pressure on the four glands so as to prevent any access of air. With this arrangement it is easy to obtain a good vacuum in the condenser, and one of the two air pumps originally installed has consequently been suppressed. As will be seen in the following table, the vacuum has, with a single air pump, been kept constant at 27 in. at all powers.

Several trials have been made with this boat from Oct. 13, 1903, up to quite recently, and the author was present at some of these trials, which were under the immediate supervision of Mr. Marriner, chief engineer to Messrs. Yarrow & Co.

First Trials.—The first trials were made on Oct. 13, 1903 each propeller carrying a single screw of three blades of 32 in. diameter, and 30 in. pitch. The following table (Table C) gives a summary of the results obtained by progressively increasing the pressure of steam supplied to the high-pressure turbine. In the first run no steam was supplied to the turbines, the reciprocating engine alone being employed, and the turbines turning idly by the action of the water on the propellers.

In the diagram, Fig. 7, the mean speed of the vessel in knots is given along the base line, and the diagram shows:

Curve A.....Steam pressure in the turbines.
Curve B.....Slip of the screw with reciprocating engines.
Curve C.....Slip of the screw with high-pressure turbines.
Curve D.....Slip of the screw with low-pressure turbines.

It will be seen from the above diagram that the estimated speed of 25 knots was obtained at the first trial, although the turbines were never working at the full effective pressure allowed for in the design, viz., 156 lbs. The curves of the slip of the screws shows that at 21 knots speed the propeller surface is sufficient, but above this speed, it is rather too small, and it was consequently decided to increase its surface by adding a second propeller to each of the shafts.

It is interesting to follow the variation in slip of the different screws, as the power of the turbines is increased. With no steam in the turbines, and the vessel being propelled by the reciprocating engine alone at a speed of about 12 knots, the slip of the central propeller is about 40 per cent, while the

TABLE C.

MESSRS. YARROW & CO.'S TORPEDO BOAT. TRIALS OF OCT. 13, 1903

Wind rather strong.

Number of trial.	I.	II.	III.	IV.	V.
Number of runs on measured mile	8	2	2	2	3
Effective pressure of steam on admission to H.P. turbine—lbs per sq. in	——	5 0	50	100	145
Condenser vacuum—inches	26 8	28	28	27 2	26 9
Speeds attained in various runs (in knots)	10 68 13 50 10 30	17 39 13 70 ——	20 06 16 76 ——	23 84 20 00 ——	27 69 22 36 27 48
Mean speed of vessel (in knots)	11 98	15 54	18 71	21 92	24 97
Rotation of reciprocating engine—Revs. per minute	369	411	441	475	516
Rotation of H.P. turbine—Revs. per minute	393	688	955	1,172	1,455
Rotation of L.P. turbine—Revs. per minute	395	687	994	1,357	1,657
E. H. P. developed on shaft of reciprocating engine	239	260	251	235	282
Slip of propellers:					
Reciprocating engine—per cent.	39 5	29 7	21 0	14 0	9 7
H.P. turbine—per cent	——	8 9	20 6	24 5	30 5
L.P. turbine—per cent	——	8 9	24 0	35 0	39 0

The E.H.P. developed on shaft was arrived at by deducting 10 per cent. from the H.P. recorded by the Watt indicator.

water causes the wing propellers to turn the turbines at the rate of about 400 revolutions per minute. As the power of the turbines increases, the slip of the middle screw is reduced to about 9 per cent, while the slip of the turbine propellers, on the contrary, beginning at zero, increases progressively to upwards of 30 per cent for the high-pressure turbine and 39 per cent for the low-pressure turbine propeller. The difference between these two figures arises from the fact that the low-pressure turbine gives notably more power than the high-pressure turbine, owing to its condenser being better than was expected.

Owing to the considerable reduction in the slip of the central propeller, as the wing propellers come more and more into play, the speed of rotation of the reciprocating engine does not increase in proportion to the speed of the vessel. By referring to the table, it will be seen that, at the reduced speed of 12 knots, the speed of rotation of the reciprocating engine is 369 revolutions, and at 25 knots (or double the first speed) only 516 revolutions per minute. On examining the curves of the turbines, it will be seen that their speed of rotation rises from 393 to 1,455 revolutions for the high-pressure turbine, and from 395 to 1,057, for the low-pressure turbine, while the speed of rotation allowed for in the design was 1,500 to 1,600 revolutions per minute. As regards the steam consumption, with the combined system of engines, this is very moderate at a speed of 10 knots, and probably considerably less than when reciprocating engines, equal to the full power required, are worked at very low powers.

Second Trials.—A second series of trials was made on Jan 19, 1904, after the propellers had been altered, the middle one being reduced to 3 ft. 6 in. diameter, the pitch being kept at 5 ft. 6 in. The high-pressure turbine was fitted with propellers of 2 ft. 4 in. and 2 ft. 8 in. diameter respectively, but both of the same pitch, while the low-pressure turbine was fitted with propellers of 2 ft. 4 in. and 2 ft. 10 in. diameter, and 2 ft. 6 in. and 2 ft. 10 in. pitch respectively. The results obtained are summarized in table D on the following page.

It will be seen that a speed of 26.39 knots has been obtained by giving the turbines rather more steam than they had been designed for. For the same steam pressure at admission, that is, for the same steam consumption, the speed is less than in the first trials except at the maximum speed, when it is about the same. The slip of the screws is much reduced, as also the speed of rotation of the turbines. It may, therefore, be inferred that two screws give better results than the single screw originally employed; for, the speed of rotation of the turbines having been greatly reduced, their efficiency is much less. To increase this speed and obtain the estimated efficiency, the pro-

peller surface must be reduced, and this was done for the third series of trials.

A point of interest is that the addition of a screw revolving in the neighborhood of the hull gave rise to considerable vibration, whereas in the first trials the complete absence of vibration was specially noteworthy.

Third Trials.—A third set of trials was made on March 4, 1904, with propellers all of the same pitch (2 ft. 6 in.) and rather smaller diameter (2 ft. 6 in., 2 ft. 4 in., 2 ft. 1 in.). The speeds obtained were approximately equal to those of the second trials, for the same steam pressures in the H. P. turbine, but the speeds of rotation of the turbines were increased by 16 per cent. The increase in the efficiency of the engines was therefore balanced by the reduction in the efficiency of the screws, the slip of which rose to 24.6 per cent for those of the H. P. turbine, and 33.1 per cent for those of the L. P.

Number of trial.	I.	II.	III.	IV.
Effective pressure of steam on admission to H.P. turbine—lbs. per sq. in	50	100	150	170
Condenser vacuum—inches	28	27.5	27	27
Speed of vessel (two runs) knots	15.58	19.25	23.22	25.714
	20.00	23.53	26.67	27.067
Mean speed of vessel—knots	17.79	21.39	24.94	26.39
Rotation of reciprocating engine—Revs. per minute	458	508	555	576
Rotation of H. P. turbine—Revs. per minute	836	1,052	1,207	1,258
Rotation of L.P. turbine—Revs. per minute	836	1,065	1,232	1,307
Slip of propellers:				
Reciprocating engine—per cent	28.7	22.4	17	15.3
H.P. turbine—per cent	13.6	17.4	16.4	14.8
L.P. turbine—per cent	24.0	28.2	27.8	27.8

turbine. It seems to be difficult to obtain more than this with propellers grouped in pairs on each shaft. This arrangement of two propellers, one in front of the other is defective in so far that the second propeller works in water already disturbed by the first propeller. The highest efficiency is certainly obtained with a single propeller on each shaft, but in order that the slip should not exceed 25 per cent, which seems to be the maximum for a good duty, the propelling surface, and consequently the diameter, must be increased. This can be easily done when the shafts are nearly horizontal. On Messrs. Yarrow's boat, the inclination of the shafts is rather steeper than it should be with propellers having a diameter greater than the pitch. Nevertheless, the speed of 26.4 knots, which has already been obtained, is no doubt capable of being improved upon, and the maximum obtained with reciprocating engines can no doubt be easily reached.

In conclusion, it will be seen from what has been said, that steam turbines can be made practically equal to reciprocating engines for propelling ships at high speeds, but in order to obtain their full effect, they must be mounted upon shafts very slightly inclined, and, if possible, with only one propeller on each shaft. The necessity for having horizontal shafts leads to a more sudden rise in the hull aft than is usual when reciprocating engines are installed. Hence, hulls constructed for reciprocating engines are not generally suitable for steam turbines. It must not be concluded from the fact that, *cæteris paribus,* a higher speed is not obtained by merely substituting turbines for reciprocating engines, that the former are therefore inferior to the latter. A new form of propelling engine obviously calls for new lines of hull. At reduced speeds, the turbines are not economical, and they are inconvenient for going astern and for maneuvering, but this drawback can quite well be remedied by combining turbines with a reciprocating engine working a special shaft and mechanically independent of the turbines. Another arrangement, different from that in the Yarrow boat, whereby the reciprocating engine would supply about 40 per cent of the total power, would give an increase of 15 to 20 per cent of the power obtained with a reciprocating engine alone, besides having the general advantages characteristic of turbines.

SUMMARY OF NAVAL CONSTRUCTION.

The commandant of the New York navy yard advises the Review that the Connecticut will be launched on Sept. 29. She is given in the naval summary of construction as 44 per cent completed as against 50 per cent for her sister, building at the yard of the Newport News Ship Building & Dry Dock Co., Newport News, Va. Following is the summary:

		Degree of completion, per cent. June 1,'04.	July 1,'04.
Battleships.			
Ohio	Union Iron Works.	94.5	96
Virginia	Newport News Co.	61.2	62.4
Nebraska	Moran Brothers Co.	49	51
Georgia	Bath Iron Works.	54.13	56.42
New Jersey	Fore River S. & E. Co.	58.7	61.8
Rhode Island	Fore River S. & E. Co.	60.7	64.1
Connecticut	Navy Yard, New York, N. Y.	42.1	44.82
Louisiana	Newport News Co.	49.31	50.79
Vermont	Fore River S. & E. Co.	8.9	10.9
Kansas	New York S. B. Co.	9.6	13.2
Minnesota	Newport News Co.	29.59	34.27
Mississippi	Wm. Cramp & Sons.	3.5	4.61
Idaho	Wm. Cramp & Sons.	3.2	4.68
Armored Cruisers.			
Pennsylvania	Wm. Cramp & Sons.	80.5	82.7
West Virginia	Newport News Co.	83.49	87.58
California	Union Iron Works.	60.5	61
Colorado	Wm. Cramp & Sons.	84.9	86.4
Maryland	Newport News Co.	82.8	85.07
South Dakota	Union Iron Works.	57.5	58
Tennessee	Wm. Cramp & Sons.	34.4	38.5
Washington	New York S. B. Co.	29.3	34.4
Protected Cruisers.			
Chattanooga	Lewis Nixon.	84.23	88.94
Galveston	Wm. R. Trigg Co.	81	84
St. Louis	Neafie & Levy Co.	42.6	43
Milwaukee	Union Iron Works.	50.5	53
Charleston	Newport News Co.	73.1	76.3
Gunboats.			
Dubuque	Gas Engine & Power Co.	42.6	47.7
Paducah	Gas Engine & Power Co.	35.7	38.7
Training Ships.			
Cumberland	Navy Yard, Boston.	42	49
Intrepid	Navy Yard, Mare Island.	23.3	33.8
Training Brig.			
Boxer	Navy Yard, Portsmouth.	42	55
Torpedo Boats.			
Stringham	Harlan & Holl'swth Co.	96	98
Goldsborough	Wolff & Zwicker.	99	99
Blakely	Geo. Lawley & Son.	99	99
Nicholson	Lewis Nixon.	99	99
O'Brien	Lewis Nixon.	98	98

The National Association of Engine & Boat Manufacturers has been definitely organized and the executive committee will meet on July 15 to elect officers. The executive committee has been selected as follows: For one year, J. B. Smalley, C. L. Alpenus, C. L. Snyder, E. A. Riotte, A. Massanet; for two years, S. J. Matthews, A. Snyder, H. B. Brautigan, A. E. Eldredge, H. R. Sutphen; for three years, John J. Amory, H. A. Lozier, Jr., J. S. Bunting, H. N. Whittelsey, J. N. Schoonmaker. It is probable that the annual meeting will be held in October. The association is organized for mutual benefit. One of the subjects discussed at the meeting was the question of freight rates. It is found that the freight rate to South America was greater than the total cost of the boat, which was regarded as unreasonable. It was also discovered that there is no uniformity whatever in the matter of freight rates.

UPBUILDING THE MERCHANT MARINE.

Mr. W. D. Sayle, president of the Cleveland Punch & Shear works, addressed the Merchant Marine Commission during its sessions in Cleveland upon the up-building of the merchant marine. As it is the purpose of the Review to give the addresses in full from time to time Mr. Sayle's address, which was exhaustive and thorough-going, is printed as follows:

"I have been requested to place before your honorable commission a few facts pertaining to our merchant marine and the interests which naturally depend upon its growth and maintenance.

"It might be proper for me to state to you that I am neither a builder of ships, nor to any extent a shipper, nor have I a dollar invested in any of the great steel carrying ships that touch our shores, but I am greatly interested as a citizen, a manufacturer and a banker, and as one who has given some little thought to this subject.

MR. W. D. SAYLE.

"One of the commonest arguments of those who are indifferent to the condition of our merchant marine is that it makes no difference in what manner our trade goes abroad so long as we enjoy rates as low as our competitors.

"This, to my notion, is only a half view of the subject. If we are to regard the mere crossing of the ocean as all, it really makes no difference, whatever, whether the goods go in American bottoms or in foreign bottoms, provided they go as cheaply; but if we are to consider the multiplication of American houses in foreign ports, the promotion of American trade in foreign countries, the loss of trade to our own steel and machinery manufacturers, the establishment of American banks in all the quarters of the world; if we are to have within ourselves the means of over-sea transportation in times of war, then we must look to it that American exports go abroad in American ships.

"We cannot hope to establish American trade through foreign branch houses and branch banks in foreign countries until the avenues of transportation between the parent houses and their offspring are entirely independent, absolutely American, and not subject either to the sanction or the forbearance of any nation.

"This was well expressed by Thomas Jefferson when he said that it is not to be by moderation and justice of others that we are to trust a fair and equal access to market for our product, or for our due share in transportation of them, but to our own means of independence and the firm will to use them.

"It were a great pity, indeed, if this question should be made a party one. In its nature it is wholly non-partisan. It is a national question and it affects equally the manufacturer, the farmer and the banker.

"Certainly at the beginning of our life as a nation these points were well understood. Washington three times applied to congress on behalf of shipping and got what he desired—the advantage of discrimination in tariff rates and tonnage dues to American shipping.

"As a branch of industry shipping was declared invaluable, but as resource of defense, imperative.

"Under beneficent legislation shipping flourished for over half a century. Then congress began gradually to tear away the bulwark which had been constructed around shipping until now it is left naked to its enemies.

"Figures are dry and I shall not quote them except to point the moral. The authenticity of my figures are based on current issues of the Marine Review, the acknowledged authority on marine statistics.

"In 1821, when our foreign carrying trade amounted to $127,000,000, we carried 88 per cent of it; now that it amounts annually to two and one-half billion dollars, we carry only a little more than 8 per cent of it. The carrying charges of this enormous volume of business are estimated at $200,000,000, of which $184,000,000 goes into foreign coffers, and most of it to Great Britain.

"I believe no one will deny that the great industries of this country have been built up under the policy of protection. Shipping flourished while it had the benefit of this policy. It will flourish again if it is protected, but it will never flourish if it is left unprotected, while at the same time all other industries are protected.

"The policy of extending protection to all industries and denying it to one, places the industry so discriminated against under a frightful handicap because it has to overcome not only foreign competition but the protection afforded to other industries as well.

"It is well known that the policy of protection has enhanced the plane of living in this country; it is well known that, owing to it, it costs more to build a ship in this country than it does abroad; it is well known that, owing to it, it costs more to operate a ship after it is built in this country than it does abroad. It is also well known that the cost of operating our ships is greatly increased by our own marine laws and licenses, issued by our government to certain crafts pertaining to our merchant marine.

"Therefore, when an American ship gets out into the high seas it is subjected to a competition that is absolutely merciless.

"We have a graphic instance of this on the great lakes today. The great bulk of traffic on the great lakes, of course, is under the coastwise laws because it is traffic from an American port to an American port. The iron ore deposits, which are the mainstay of lake trade, are all in American territory. Therefore, on account of natural resources and wise coastwise laws, practically 96 per cent of the commerce of the great lakes, as shown by the records at the Soo, is carried in American ships, while less than 8 per cent only the foreign commerce that rightfully belongs to American ships is carried by them.

"A considerable portion of the grain trade, however, which originates in this country goes to Canada, so that it is international in character and therefore subject to the competition of all nations.

"An American company, the Great Lakes & St. Lawrence Transportation Co., is engaged in the grain and package freight business from Duluth to Montreal. This is international trade and is open to all ships. The company has been operating a fleet of ten American steamers, but this year in addition has chartered two Norwegian ships to help in the service. These ships are chartered for a lump sum, the masters providing everything save fuel. The Great Lakes & St. Lawrence Transportation Co. was surprised to discover that the sum worked out to a figure 40 per cent less than it costs them to operate their American ships of equal tonnage. The American seaman demands better wages, better quarters and better food. How long do you suppose such a condition is going to last when such a differential exists? Will the capitalist continue blind to his profit, or will he bring over other Norwegian ships to engage in this trade when he realizes that there is a gain of 40 per cent in operating expense by doing so?

"This question, gentlemen, is one that comes right home to us. An American policy has bred it, and an American policy should remedy it.

"This inequality, produced, as I say, by an essentially American policy, should be equalized by the general government. I would not undertake to say in what manner it should be brought about. That is the business of this commission to discover. All that I desire to impress upon you is the fact that it does not concern any one citizen or any set of citizens, but all citizens.

"The benefit of wise assistance to our merchant marine would so widely permeate the active industries of the country that it cannot be said that any one interest would be especially benefited. What I meant to say is that the shipowner and shipbuilder will not be the sole beneficiaries. Ship building is an industry which consumes a great many products and furnishes employment to nearly every other industry in the country. For one ship yard that is revived a hundred corelated industries are stimulated.

"As an example I will point out to you how the city of Cleveland and vicinity will be benefited by the revival of the shipbuilding industry.

"We have in this city firms who make a specialty of the manufacture and sale of the following articles which are used in the shipbuilding trade: steel plate, rivets, rope, blocks and tackle, nut and bolt machinery, punching and shearing machinery, and all the varied etcetera pertaining to the outfitting of a ship, including water tight bulkhead doors used in battleships.

"It is possible that an entire ship could be built and fully equipped from material manufactured from the raw in this city. I might say that in deciding what is the best thing to be done it might be well to be guided by those policies of other nations which have proved so successful. It is well known that at the beginning of commercial ocean steam navigation in 1838, the United States possessed more steam vessels than Britain. The figures were 193,423 tons for the United States and 74,684 tons for Britain. We can follow this procession of steamers down to 1860 with some show of pride, for in that year the steam tonnage of the United States was 807,937, as against 452,352 tons for Britain. But our ascendancy ends there. Britain a few years before had put her merchant marine into the hands of the Board of Trade where it might be intelligently pushed forward by experts, and she also adopted the general policy of establishing ocean lanes for steam navigation to foreign countries through the aid of liberal subsidies for carrying the mails.

"In ten years she paid $52,000,000 in subsidies to steamship lines—an amount which was very much greater than the original cost of the fleets of steamers employed in the service. This policy exerted a powerful influence in the development of British steam navigation and in the extension of British ship yards. She has pursued that policy so continuously and determinedly that she now has 8,535 carriers of 14,193,582 tons. The United States has but 1,200 carriers, and nearly half of these are on the great lakes. Potentially, however, the figures are very much greater. A steamer of equal tonnage is a more convenient vehicle than a sailing ship of equal tonnage, for the ability of a steamer to make quick and numerous trips is greater than that of the sailing ship. The potential tonnage of the British merchant fleet, which is nearly all steam, is figured at 36,607,579 tons, as against 6,003,704 for the United States.

"Of course, all this shipping is not subsidized; nor is it necessary that it should be. Lanes of trade having been established to foreign countries by combined mail, and freight carriers under generous subsidies, trade has simply followed the flag, until now for a remote country to trade with Great Britain has become as natural as the ebb and flow of the tides.

"The net earnings of Britain's merchant fleet frequently equal the combined earnings of all the railroads in the United States. The earnings of the British merchant marine, which are calculated roundly at $550,000,000, equal in value the entire wheat crop of the United States. These earnings are to be regarded as part of the exports of Britain just as much so as if they were a commodity.

"I am not in favor of aid for an indefinite period of years. I am in favor of it until American trade lanes have been established to foreign countries similar to those which have been established for Great Britain—so long and no longer. I have no favorite form of remedy to recommend. I do not care whether it be by direct subsidy to the ship; whether it be by a difference in the duty which goods must pay when brought to this country by foreign ships; whether it be exacted by tonnage dues; whether a bounty be paid for outward voyages, or whether it be by one or all of them, so long as the thing is accomplished.

"Whatever form of help you deem advisable to give to American ships, I would suggest that such ships as accept the assistance tendered should be compelled to work under certain laws or regulations pertaining to the employment of help, with the end in view of educating as many seamen as possible, who could be used in times of war or from whom the government could fill the demand for able seamen on its ships of war.

"I am not afraid of the word subsidy, nor do I think it a bugaboo, as many of our good people do.

"Stop and consider how many hundreds of millions of dollars we have invested in ships of war and how many millions are now being expended—for what purpose? To protect a merchant marine that does not exist, and a few hardy merchants who, without assistance, are fighting for trade in the camp of the enemy. The Philippine islands, and other islands dominated by this government, will, of necessity, become, sooner or later, great consumers of goods manufactured in this country. Thousands of tons of material will be needed in the construction and maintenance of our great inter-ocean waterway which will soon be under construction. Why cannot some scheme be devised, as a beginning, whereby all such trade must be carried in American bottoms or be compelled to pay a tonnage differential? Some such scheme must be devised by your honorable body, and as patriotic citizens I think that something ought to be done to revive in this county an industry upon which the integrity of our export trade is absolutely dependent."

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U. S. Engineer Office, Duluth, Minn., July 8, 1904. Sealed proposals for building vessel yard, and removing buildings at Duluth, Minn., will be received here until noon, Aug. 8, 1904, and then publicly opened. Information on application. CHAS. L. POTTER, Capt., Engineers. Aug. 4

PROPOSAL FOR CONSTRUCTION OF BREAKWATER.—U. S. Engineer Office, 262 Huron Street, Cleveland, Ohio, June 18, 1904. Sealed proposals for constructing the East Breakwater at Black River (Lorain) Harbor, Ohio, will be received at this office until 2 P. M., July 18th, 1904, and then publicly opened. Specifications, blank forms, and all available information will be furnished on application to this office. DAN C. KINGMAN, Major, Corps of Engineers, U. S. Army. July 14

U.S. Engineer Office, 1637 Indiana Ave., Chicago, Ill., June 25, 1904. Sealed proposals for dredging in Calumet River, Ill., will be received here until 12 noon, July 26, 1904, and then publicly opened. Information on application. O. H. ERNST, Col., Engineers. July 21

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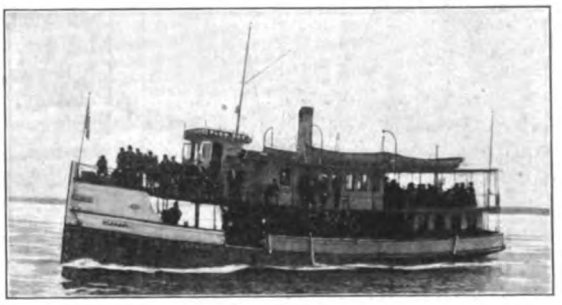

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Naval Architects and Engineers.
Chartering and Brokerage.
Maritime Bldg., New York.
NEW YORK. DETROIT.

NAVAL ARCHITECTS' AND ENGINEERS' DATA BOOK,
By T. H. WATSON.
Price, $1.50
THE PENTON PUB. CO.,
Cleveland, O.

PATENTS.

Buyers' Directory of the Marine Trade

For a more complete classification than that represented by advertisers in the Marine Review, see the BLUE BOOK OF AMERICAN SHIPPING, marine and naval directory of the United States, published by the Marine Review, 39-41 Wade Bldg., Cleveland.

See accompanying index of Advertisers for full addresses of concerns in this directory.

AIR COMPRESSORS, AIR HOISTS, ETC.
Dake Engine Co.....Grand Haven, Mich.
Great Lakes Engineering Works.....Detroit.
Mietz, Aug. .....New York.

AIR PORTS, DEAD LIGHTS, ETC.
Marine Mfg. & Supply Co.....New York.

AIR PUMPS AND APPLIANCES.
Fore River Ship & Engine Co..Quincy, Mass.
Great Lakes Engineering Works.....Detroit.

ANCHORS.
Baldt Anchor Co.....Chester, Pa.
Bowers, L. M. & Co.....Binghamton, N. Y.
DeGrauw, Aymar & Co.....New York.
Seaboard Steel Casting Co.....Chester, Pa.

ANTI-FRICTION METALS.
Cramp, Wm. & Sons.....Philadelphia.
Phosphor Bronze Smelting Co., Ltd.....
.....Philadelphia.
Victor Metals Co.....Braintree, Mass.

ARTIFICIAL DRAFT FOR BOILERS.
American Ship Building Co.....Cleveland.
Detroit Ship Building Co.....Detroit.
Great Lakes Engineering Works.....Detroit.
Sturtevant, B. F., Co. .....Hyde Park Mass.

ASH EJECTORS.
Great Lakes Engineering Works.....Detroit.

ATTORNEYS AND PROCTORS IN ADMIRALTY.
Faust, Lieut. Wm. H.....Buffalo.
Gilchrist, Albert J.....Cleveland.
Goulder, Holding & Masten.....Cleveland.
Hoyt, Dustin & Kelley.....Cleveland.
Kremer, C. E.....Chicago.
MacDonald, Ray G.....Chicago.
Potter & Potter .....Buffalo.
Shaw, Warren, Cady & Oakes.....Detroit.
White, Johnson, McCaslin & Cannon Cleveland.

BAROMETERS, MARINE GLASSES, ETC.
Ritchie, E. S. & Sons.....Brookline, Mass.

BELTING, RUBBER.
New York Belting & Packing Co....New York.

BLOCKS, SHEAVES, ETC.
Boston & Lockport Block Co....Boston, Mass.
Cleveland Block Co.....Cleveland.

BLOWERS.
Sturtevant, B. F. Co. .....Hyde Park, Mass.

BOAT BUILDERS.
Drein, Thos. & Son.....Wilmington, Del.
Kahnweiler's Sons, David.....New York.
Lane & DeGroot ....Long Island City, N. Y.
Marine Construction & D. D. Co.....
.....Mariner's Harbor, S. I., N. Y.
Truscott Boat Mfg. Co....St. Joseph, Mich.
Willard, Chas. P. & Co.....Chicago.

BOILER MANUFACTURERS.
Almy Water Tube Boiler Co.Providence, R. I.
American Ship Building Co.....Cleveland.
Atlantic Works .....East Boston, Mass.
Babcock & Wilcox Co.....New York.
Bertram Engine Works Co., Ltd. .....
.....Toronto, Can.
Chicago Ship Building Co.....Chicago.
Cramp, Wm. & Sons.....Philadelphia.
Delauney, Belleville & Co..St. Denis, France.
Detroit Ship Building Co.....Detroit.
Fletcher, W. A. & Co.....Hoboken, N. J.
Fore River Ship & Engine Co..Quincy, Mass.
Forest City Boiler Co.....Cleveland.
Georgian Bay Engineering Works.....
.....Midland, Ont.
Gogebic Steam Boiler Works....Duluth, Minn.
Great Lakes Engineering Works.....Detroit.
Jenks Ship Building Co....Port Huron, Mich.
Kingsford Foundry & Machine Works....
.....Oswego, N. Y.

BOILER MANUFACTURERS—Continued.
Milwaukee Dry Dock Co.....Milwaukee.
Mosher Water Tube Boiler Co....New York.
Newport News Ship Building Co.....
.....Newport News, Va.
Northwestern Steam Boiler & Mfg. Co....
..... Duluth, Minn.
Roberts Safety Water Tube Boiler Co....
..... New York.
Stirling, The Co.....Chicago.
Superior Ship Building Co....Superior, Wis.
Taylor Water Tube Boiler Co.....Detroit.
Union Machine & Boiler Co.....Cleveland.
United States Ship Building Co....New York.
Willard, Chas. P. & Co.....Chicago.

BOILER COMPOUNDS.
Dearborn Drug & Chemical Works....Chicago.

BOILER RIVETS.
Bourne-Fuller Co.....Cleveland.

BOILER STAYBOLTS, IRON OR STEEL, HOLLOW OR SOLID.
Falls Hollow Staybolt Co..Cuyahoga Falls, O.

BOILER TUBES.
Bourne-Fuller Co. .....Cleveland.

BOOKS. NAUTICAL AND ENGINEERING.
Marine Review Pub. Co.....Cleveland.

BRASS AND BRONZE CASTINGS.
Cramp, Wm. & Sons.....Philadelphia.
Fore River Ship & Engine Co..Quincy, Mass.
Great Lakes Engineering Works.....Detroit.
Lunkenheimer Co. .....Cincinnati.
Macbeth Iron Co.....Cleveland.
Phosphor Bronze Smelting Co....Philadelphia.
Victor Metals Co.....Braintree, Mass.

BRIDGES, BUILDERS OF.
Scherzer Rolling Lift Bridge Co....Chicago.

BUCKETS, ORE AND COAL.
Brown Hoisting & Conveying Machine Co.
..... Cleveland.
Forest City Boiler Co. .....Cleveland.
Macbeth Iron Co. .....Cleveland.

CABIN AND CABINET FINISHING WOODS.
Martin-Barriss Co.....Cleveland.

CAPSTANS.
American Ship Windlass Co..Providence, R. I.
Hyde Windlass Co.....Bath, Me.
Marine Mfg. & Supply Co.....New York.

CEMENT, IRON FOR REPAIRING LEAKS.
Smooth-On Mfg. Co.....Jersey City, N. J.

CHAINS.
Lebanon Chain Works.....Lebanon, Pa.

CHAIN HOISTS.
Boston & Lockport Block Co....Boston, Mass.
Dake Engine Co.....Grand Haven, Mich.

CHARTS.
Marine Review Pub. Co.....Cleveland.
Potter, J. D.....London.

CLOCKS (Marine and Ship's Bell) AND CHRONOMETERS.
Ashton Valve Co.....Boston.
Ritchie, E. S. & Sons.....Brookline, Mass.
Standard Gauge Mfg. Co.....Syracuse, N. Y.

COAL PRODUCERS AND SHIPPERS.
Hanna, M. A. & Co.....Cleveland.
Pickands, Mather & Co.....Cleveland.
Pittsburg Coal Co.....Cleveland.

COAL AND ORE HANDLING MACHINERY.
Brown Hoisting Machinery Co. (Inc.) ..
..... Cleveland.
Lidgerwood Mfg. Co.....New York.
Macbeth Iron Co.....Cleveland.

COMPASS ADJUSTERS.
Fields, Capt. J. M.....Cleveland.

COMPASSES.
Ritchie, E. S. & Sons.....Brookline, Mass.

CONCRETE MIXERS.
Contractors Supply & Equipment Co..Chicago.

CONDENSORS.
Great Lakes Engineering Works.. Detroit.
Thropp & Sons Co., John E.....Trenton, N. J.

CONTRACTORS SUPPLIES.
Contractors Supply & Equipment Co., Chicago.

CONTRACTORS FOR PUBLIC WORKS.
Buffalo Dredging Co.....Buffalo.
Chicago & Gt. Lakes Dredge & Dock Co.
..... Chicago.
Dunbar & Sullivan Dredging Co.....Buffalo.
Fitz-Simons & Connell Co.....Chicago.
Hickler Bros. .....Sault Ste. Marie, Mich.
Smith Co., L. P. & J. A.....Cleveland.
Starke Dredge & Dock Co., C. H..Milwaukee.
Sullivan, M. .....Detroit.

CORDAGE.
Baker & Co., H. H.....Buffalo.
DeGrauw, Aymar & Co.....New York.
Upson-Walton Co.....Cleveland.

CORK JACKETS AND RINGS.
Armstrong Cork Co.....Pittsburg, Pa.
Kahnweiler's Sons, D.....New York.

COURSE FINDER.
Field's Patent Course Finder.....Cleveland.

CHAIN CONVEYORS, HOISTS.
Brown Hoisting Machinery Co. (Inc.)....
..... Cleveland.
General Electric Co.....Schenectady, N. Y.
Lidgerwood Mfg. Co.....New York.
Westinghouse Electric & Mfg. Co.....
.....Pittsburg, Pa.

CRANES, TRAVELING.
Brown Hoisting Machinery Co.....Cleveland.
Lidgerwood Mfg. Co.....New York.
Pawling & Harnischfeger.....Milwaukee.

DIVING APPARATUS.
Morse, A. J. & Son.....Boston.
Schrader's Son, A.....New York.

DREDGING CONTRACTORS.
Buffalo Dredging Co.....Buffalo.
Chicago & Gt. Lakes Dredge & Dock Co..
..... Chicago.
Dunbar & Sullivan Dredging Co.....Buffalo.
Fitz-Simons & Connell Co.....Chicago.
Hickler Bros. .....Sault Ste. Marie, Mich.
Smith Co., L. P. & J. A.....Cleveland.
Starke Dredge & Dock Co., C. H...Milwaukee.
Sullivan, M. .....Detroit.

DRYING APPARATUS.
Bayley & Sons Co., Wm.....Milwaukee, Wis.
Sturtevant, B. F., Co. .....Hyde Park, Mass.

DRY DOCKS.
American Ship Building Co.....Cleveland.
Atlantic Works .....East Boston, Mass.
Buffalo Dry Dock Co.....Buffalo.
Chicago Ship Building Co.....Chicago.
Craig Ship Building Co.....Toledo, O.
Cramp, Wm. & Sons.....Philadelphia.
Detroit Ship Building Co.....Detroit.
Great Lakes Engineering Works.....Detroit.
Lockwood Mfg. Co.....East Boston, Mass.
Manitowoc Dry Dock Co.....Manitowoc, Wis.
Milwaukee Dry Dock Co.....Milwaukee.
Newport News Ship Building Co.....
.....Newport News, Va.
Shipowners Dry Dock Co.....Chicago.
Superior Ship Building Co....Superior, Wis.
United States Ship Building Co....New York.

Buyers' Directory of the Marine Trade.—*Continued.*

ELECTRIC HOISTS AND CRANES.

General Electric Co.....Schenectady, N. Y.
Lidgerwood Mfg. Co.....New York.
Pawling & Harnischfeger.....Milwaukee.
Westinghouse Electric & Mfg. Co.....
..... Pittsburg, Pa.

ELECTRIC LIGHT AND POWER PLANTS.

Bayley & Sons Co.....Milwaukee, Wis.
General Electric Co.....Schenectady, N. Y.
Metz, Aug.....New York.
Sturtevant, B. F. Co.....Hyde Park, Mass.
Stupp & Sons, John E.....Trenton, N. J.
Westinghouse Electric & Mfg. Co.....
..... Pittsburg, Pa.

ENGINE BUILDERS, MARINE.

American Ship Building Co.....Cleveland.
Atlantic Works.....East Boston, Mass.
Bertram Engine Works Co., Ltd.....
..... Toronto, Can.
Chicago Ship Building Co.....Chicago.
Chase Machine Co.....Cleveland.
Cramp, Wm. & Sons.....Philadelphia.
Craig Ship Building Co.....Toledo, O.
Lake Engine Co.....Grand Haven, Mich.
Detroit Ship Building Co.....Detroit.
Dreher, W. & A. Co.....Hoboken, N. J.
Fore River Ship & Engine Co..Quincy, Mass.
Great Lakes Engineering Works Detroit, Mich.
Hall Bros.....Philadelphia.
Jenks Ship Building Co....Port Huron, Mich.
Lawley, W. & Sons Co.....East Boston, Mass.
Macbeth Iron Co.....Cleveland.
Metz, Aug.....New York.
Milwaukee Dry Dock Co.....Milwaukee.
Mosher, Chas. D.....New York.
Mumford Steering Engine Co.....New York.
Newport News Ship Building Co.....
.....Newport News, Va.
Northwestern Steam Boiler & Mfg. Co....
.....Duluth, Minn.
Roach's Ship Yard .....Chester, Pa.
Samuels Mfg. Co.....Milwaukee.
Superior Ship Building Co....Superior, Wis.
Stupp, J. E. & Sons Co.....Trenton, N. J.
Tosi, H. G.....Buffalo.
United States Ship Building Co....New York.
Willard, Chas. P. & Co.....Chicago.

ENGINE ROOM TELEGRAPH, CALL BELLS, ETC.

Clark, Chas. & Son.....New York.
Marine Mfg. Supply Co.....New York.

ENGINEERING SPECIALTIES AND SUPPLIES.

Crane Co.....Chicago.
Kerby & Mueller .....New York.
Lunkenheimer Co. .....Cincinnati.
Morris & Co., H.....Milwaukee.
New York Belting & Packing Co..New York.
Northwestern Steam Boiler & Mfg. Co....
.....Duluth, Minn.

ENGINEERS, MARINE, MECHANICAL, CONSULTING.

Boyd, Alexander .....Cleveland.
Brett, Robt. W. & Co.....Chicago.
Buell, Joseph .....Duluth, Minn.
Buell, H. O.....Buffalo.
Cramp & Sons .....Philadelphia.
Mosher, Chas. D.....New York.
Neary, James .....Cleveland.
Pittsburg Testing Laboratory, Ltd...Pittsburg.
Rice, Henry .....Buffalo.
Roelker, H. B.....New York.
Sawyer, Perkins & Field.....New York.
Speer, Adam .....Cleveland.
Ward, W. J. .....Chicago.

FANS FOR VENTILATION, EXHAUST, ETC.

Sturtevant, B. F. Co.....Hyde Park, Mass.

FEED WATER PURIFIERS AND HEATERS.

Kerby Valve Co.....Troy, N. Y.

FIXTURES FOR LAMPS, OIL OR ELECTRIC.

General Electric Co.....Schenectady, N. Y.
Westinghouse Electric & Mfg. Co.....
.....Pittsburg, Pa.

FORGES.

Sturtevant, B. F. Co.....Boston.

FORGINGS FOR CRANK, PROPELLER OR THRUST SHAFTS, ETC.

Cleveland City Forge & Iron Co....Cleveland.
Fore River Ship & Engine Co..Quincy, Mass.
Macbeth Iron Co.....Cleveland.

FLUE WELDING.

Fix's, S. Sons .....Cleveland.

FURNACES FOR BOILERS.

Continental Iron Works.....New York.

FUELING COMPANIES AND COAL DEALERS.

Hanna, M. A. & Co.....Cleveland.
Ironville, Dock & Coal Co.....Toledo, O.
Parker Bros. Co., Ltd.....Detroit.
Picklands, Mather & Co.....Cleveland.
Pittsburg Coal Co.....Cleveland.
Smith, Stanley B., & Co.....Detroit,
Smith Coal & Dock Co., Stanley B.Toledo, O.

GASKETS, RUBBER.

New York Belting & Packing Co..New York.

GAS BUOYS.

Safety Car Heating & Lighting Co..New York.

GAS AND GASOLINE ENGINES.

Chase Machine Co.....Cleveland.
Georgian Bay Engineering Works.....
..... Midland, Ont.
Reliance Mfg. Co.....City Island, New York.

GAUGES, STEAM AND VACUUM.

American Steam Gauge & Valve Mfg. Co.
..... Boston.
Ashton Valve Co.....Boston.
Lunkenheimer Co. .....Cincinnati.
Standard Gauge Mfg. Co.....Syracuse, N. Y.

GAUGES, WATER.

Bonner & Co., Wm. T.....Boston.
Lunkenheimer Co. .....Cincinnati, O.
Standard Gauge Mfg. Co.....Syracuse, N. Y.

GRAPHITE.

Dixon Crucible Co., Joseph..Jersey City, N. J.

HAMMERS, STEAM.

Chase Machine Co.....Cleveland.

HEATING APPARATUS.

Bayley & Sons Co., Wm.....Milwaukee, Wis.
Sturtevant, B. F. Co.....Hyde Park, Mass.

HOISTS FOR CARGO, ETC.

American Ship Building Co.....Cleveland.
Brown Hoisting Machinery Co. (Inc.)....
..... Cleveland.
Chase Machine Co.....Cleveland.
Elwell-Parker Electric Co.....Cleveland.
General Electric Co.....New York.
Georgian Bay Engineering Works.....
..... Midland, Ont.
Hyde Windlass Co.....Bath, Me.
Lidgerwood Mfg. Co.....New York.
Marine Iron Co.....Bay City.
Mietz, Aug. .....New York.
Pawling & Harnischfeger .....Milwaukee.
Westinghouse Electric & Mfg. Co.....
.....Pittsburg, Pa.

HOLLOW STAYBOLT IRON.

Falls Hollow Staybolt Co...Cuyahoga Falls, O.

HOSE, RUBBER.

New York Belting & Packing Co..New York.

HYDRAULIC DREDGES.

Great Lakes Engineering Works.....Detroit.

HYDRAULIC TOOLS.

Watson-Stillman Co., The.....New York.

ICE MACHINERY.

Great Lakes Engineering Works.....Detroit.
Roelker, H. B.....New York.

INDICATORS FOR STEAM ENGINES.

American Steam Gauge Co.....Boston.
Ashton Valve Co.....Boston.

INJECTORS.

American Injector Co.....Detroit.
Crane Co. .....Chicago.
Jenkins Bros. .....New York.
Lunkenheimer Co. .....Cincinnati.
Penberthy Injector Co.....Detroit, Mich.

INSURANCE, MARINE.

Elphicke, C. W. & Co.....Chicago.
Fleming & Co., P. H.....Chicago.
Frankfort Marine, A. & P. G. Ins. Co....
..... New York.

INSURANCE, MARINE—Continued.

Gilchrist & Co., C. P.....Cleveland.
Hawgood & Co., W. A.....Cleveland.
Helm & Co., D. T.....Duluth.
Hutchinson & Co.....Cleveland.
McCarthy, T. R.....Montreal.
McCurdy, Geo. L.....Chicago.
Mitchell & Co.....Cleveland.
Parker Bros. Co., Ltd.....Detroit.
Peck, Chas. E. & W. F..New York & Chicago.
Prindiville & Co.....Chicago.
Richardson, W. C.....Cleveland.
Sullivan, D. & Co.....Chicago.
Voss, F. D.....New York.
Weeks, F. H.....New York.

IRON ORE AND PIG IRON.

Bourne-Fuller Co.....Cleveland.
Hanna, M. A. & Co.....Cleveland.
Pickands, Mather & Co.....Cleveland.

LAUNCHES—STEAM, NAPHTHA, ELECTRIC.

Georgian Bay Engineering Works.....
..... Midland, Ont.
Marine Construction & D. D. Co.....
.....Mariner's Harbor, S. I., N. Y.
Truscott Boat Mfg. Co.....St. Joseph, Mich.
Willard, Chas. P.....Chicago.

LIFE PRESERVERS, LIFE BOATS, BUOYS.

Armstrong, Cork Co.....Pittsburg.
Dreim, Thos. & Son.....Wilmington, Del.
Kahnweiler's Sons, D. .....New York

LIGHTS, SIDE AND SIGNAL.

Russell & Watson .....Buffalo.

LOGS.

Walker & Sons, Thomas ....Birmingham, Eng.
Also Ship Chandlers.

LUBRICATING GRAPHITE.

Dixon Crucible Co., Joseph..Jersey City, N. J.

LUBRICATORS.

Crane Co. .....Chicago.
Lunkenheimer Co. .....Cincinnati.

LUMBER.

Martin-Barriss Co.....Cleveland.

MACHINISTS.

Chase Machine Co.....Cleveland.
Gogebic Steam Boiler Works....Duluth, Minn.
Hickler Bros. .....Sault Ste. Marie, Mich.
Lockwood Mfg. Co.....East Boston, Mass.
Macbeth Iron Co.....Cleveland.
Union Machine & Boiler Co.....Cleveland.

MACHINE TOOLS (WOOD WORKING).

Atlantic Works, Inc.....Philadelphia.

MARINE RAILWAYS.

Hickler Bros. .....Sault Ste. Marie, Mich.

MARINE GLUE.

Ferdinand & Co., L. W.....Boston, Mass.

MARINE RAILWAYS, BUILDERS OF.

Crandall & Son, H. I....East Boston, Mass.

MATTRESSES, CUSHIONS, BEDDING.

Fogg, M. W.....New York.

MECHANICAL DRAFT FOR BOILERS.

American Ship Building Co.....Cleveland.
Detroit Ship Building Co.....Detroit.
Great Lakes Engineering Works ..Detroit.
Sturtevant, B. F. Co.....Hyde Park, Mass.

MELTING POT AND PAYING LADLE.

(For Paying Seams of Decks with Marine Glue.)

Ferdinand & Co., L. W.....Boston.

METALLIC PACKING.

Katzenstein, L. & Co.....New York.

METAL POLISH.

Bertram's Oil Polish Co.....Boston

MOTORS, GENERATORS—ELECTRIC.

General Electric Co.....Schenectady, N. Y.
Bayley & Sons Co., Wm.....Milwaukee, Wis.
Sturtevant, B. F. Co.....Hyde Park, Mass.
Westinghouse Electric & Mfg. Co.....
..... Pittsburg, Pa.

Buyers' Directory of the Marine Trade.—*Continued.*

NAUTICAL INSTRUMENTS.
Ritchie, E. S., & Sons.....Brookline, Mass.

NAVAL ARCHITECTS.
Hynd, Alexander .....Cleveland.
Kidd, Joseph.....Duluth, Minn.
Lovejoy, H. O.....Buffalo.
Matteson & Drake.....Philadelphia.
Mosher, Chas. D.....New York.
Nacey, James .....Cleveland.
Rice, Henry .....Buffalo.
Sadler, Perkins & Field.....New York.
Steel, Adam .....Cleveland.
Wood, W. J.....Chicago.

OAKUM.
DeGrauw, Aymar & Co.....New York.
Stratford, Oakum Co.....Jersey City, N. J.

OIL FOR PAINTING.
Sipe & Co., James B.....Allegheny, Pa.

OIL ENGINES.
Mietz, Aug. .....New York.

OILS AND LUBRICANTS.
Dixon Crucible Co., Joseph..Jersey City, N. J.
Standard Oil Co.....Cleveland.

PACKING.
Crane Co. .....Chicago.
Jenkins Bros. .....New York.
Katzenstein, L. & Co.....New York.
New York Belting & Packing Co...New York.

PACKING TOOL.
Matteson & Drake .....Philadelphia.

PAINTS.
Baker, Howard H. & Co.....Buffalo.
Detroit Varnish Co.....Detroit.
Detroit White Lead Works.....Detroit.
Forest City Paint and Varnish Co..Cleveland.
New Jersey Zinc Co.....New York.
Sipe & Co., James B.....Allegheny, Pa.
Upson-Walton Co. .....Cleveland.

PATTERN SHOP MACHINERY.
Atlantic Works, Inc.....Philadelphia.

PILE DRIVING AND SUBMARINE WORK.
Buffalo Dredging Co.....Buffalo.
Chicago & Gt. Lakes Dredge & Dock Co.. .....Chicago.
Dunbar & Sullivan Dredging Co.....Buffalo.
Fitz-Simons & Connell Co.....Chicago.
Hickler Bros. .....Sault Ste. Marie, Mich.
Parker Bros. Co., Ltd.....Detroit.
Smith Co., L. P. & J. A.....Cleveland.
Starke Dredge & Dock Co., C. H...Milwaukee.
Sullivan, M. .....Detroit.

PIPE, WROUGHT IRON.
Bourne-Fuller Co.....Cleveland.
Crane Co. .....Chicago.
Macbeth Iron Co.....Cleveland.

PLANING MILL MACHINERY.
Atlantic Works, Inc.....Philadelphia.

PLATES—SHIP, STRUCTURAL, ETC.
Bourne-Fuller Co. .....Cleveland.
Otis Steel Co.....Cleveland.

PNEUMATIC TOOLS.
Allen, John F.....New York.

POLISH FOR METALS.
Bertram's Oil Polish Co.....Boston.

PRESSURE REGULATORS.
Kieley & Mueller .....New York.
Ross Valve Co.....Troy, N. Y.

PROPELLER WHEELS.
American Ship Building Co.....Cleveland.
Atlantic Works .... East Boston, Mass.
Cramp, Wm. & Sons.....Philadelphia.
Detroit Ship Building Co.....Detroit.
Fore River Ship & Engine Co..Quincy, Mass.
Great Lakes Engineering Works.. Detroit.
Hyde Windlass Co.....Bath, Me.
Jenks Ship Building Co....Port Huron, Mich.
Lockwood Mfg. Co.....East Boston, Mass.
Macbeth Iron Co.....Cleveland.
Milwaukee Dry Dock Co.....Milwaukee.
Newport News Ship Building Co..... .....Newport News, Va.
Phosphor Bronze Smelting Co., Ltd..... .....Philadelphia.
Roelker, H. B.....New York.
Sheriffs Mfg. Co.....Milwaukee.
Superior Ship Building Co....Superior, Wis.
Thropp & Sons Co., J. E.....Trenton, N. J.
Trout, H. G.....Buffalo.
United States Ship Building Co....New York.

PROJECTORS, ELECTRIC.
General Electric Co.....Schenectady, N. Y.
Westinghouse Electric & Mfg. Co..... .....Pittsburg, Pa.

PUMPS FOR VARIOUS PURPOSES.
Blake, Geo. F., Mfg. Co.....New York.
Great Lakes Engineering Works Detroit.
Kingsford Foundry & Machine Works.... .....Oswego, N. Y.

PUNCHES, RIVETERS, SHEARS.
Allen, John F. .....New York.

RANGES.
Russell & Watson .....Buffalo

REFRIGERATING APPARATUS.
Great Lakes Engineering Works.....Detroit.
Roelker, H. B. .....New York.

REGISTER FOR CLASSIFICATION OF VESSELS.
Great Lakes Register .....Cleveland.
Record of American & Foreign Shipping.. .....New York.

REPAIRS—ENGINE AND BOILER.
(See also Boiler Manufacturers and Engine Builders.)
Georgian Bay Engineering Works..... .....Midland, Ont.
Gogebic Steam Boiler Works....Duluth, Minn.
Forest City Boiler Co.....Cleveland.
Marine Iron Co.....Duluth, Minn.

RIVETING MACHINES.
Allen, John F.....New York.

RIVETS, STEEL, FOR SHIPS AND BOILERS.
Bourne-Fuller Co.....Cleveland.

SAFETY VALVES.
American Steam Gauge & Valve Mfg. Co. .....Boston.
Ashton Valve Co.....Boston.
Crane Co. .....Chicago.
Lunkenheimer Co. .....Cincinnati.

SAIL MAKERS.
Baker, Howard H. & Co.....Buffalo.
Upson-Walton Co.....Cleveland.
Wilson & Silsby .....Boston.

SALVAGE COMPANIES.
See Wrecking Companies.

SEARCH LIGHTS.
General Electric Co.....Schenectady, N. Y.
Westinghouse Electric & Mfg. Co..... .....Pittsburg, Pa.

SHEARS.
See Punches, Rivets, and Shears.

SHIP AND BOILER PLATES AND SHAPES.
Bourne-Fuller Co.....Cleveland.
Otis Steel Co.....Cleveland.

SHIP BUILDERS.
American Ship Building Co.....Cleveland.
Atlantic Works .....East Boston, Mass.
Bertram Engine Works Co., Ltd.Toronto, Can.
Buffalo Dry Dock Co.....Buffalo.
Cramp, Wm. & Sons.....Philadelphia.
Craig Ship Building Co.....Toledo, O.
Chicago Ship Building Co.....Chicago.
Detroit Ship Building Co.....Detroit.
Fore River Ship & Engine Co..Quincy, Mass.
Great Lakes Engineering Works.....Detroit.
Jenks Ship Building Co....Port Huron, Mich.
Lockwood Mfg. Co.....East Boston, Mass.
Manitowoc Dry Dock Co.....Manitowoc, Wis.
Milwaukee Dry Dock Co.....Milwaukee.
Newport News Ship Building Co..... .....Newport News, Va.
Roach's Ship Yard .....Chester, Pa.
Shipowner's Dry Dock Co.....Chicago.
Smith & Son, Abram.....Algonac, Mich.
United States Ship Building Co..New York.
Willard, Chas. P. & Co.....Chicago.

SHIP CHANDLERS.
Baker, Howard H. & Co.. .....Buffalo.
Marine Mfg. & Supply Co.....New York.
Upson-Walton Co.....Cleveland.

SHIP LANTERNS AND LAMPS.
Russell & Watson .....Buffalo.

SHIP TIMBER.
Martin-Barriss Co.....Cleveland.

SMOOTH-ON COMPOUND, FOR REPAIRS.
Smooth-On Mfg. Co.....Jersey City, N. J.

STAYBOLTS, IRON OR STEEL, HOLLOW OR SOLID.
Falls Hollow Staybolt Co..Cuyahoga Falls, O.

STEAM VESSELS FOR SALE.
Elwell, Jas. W. & Co.....New York.
Gilchrist & Co., C. P. .....Cleveland.
Holmes, Samuel .....New York.
Lester, S. S. ..... Quebec, Can.
McCarthy, T. R.....Montreal, Can.
Weeks, F. H.....New York.

STEAMSHIP LINES, PASS. AND FREIGHT.
American Line .....New York.
Anchor Line .....Buffalo.
Cleveland & Buffalo Transit Co.....Cleveland
Detroit & Cleveland Line. .....Cleveland.
Erie & Western Trans. Co.....Buffalo.
Goodrich Trans. Co.....Chicago.
International Mercantile Marine Co..... .....Philadelphia.
Manitou Steamship Co.....Chicago.
Mexican-American S. S. Co..New Orleans, La.
New York & Cuba Mail S. S. Co.... New York.
Niagara, St. Catharines & Toronto Ry. & Nav. Co. .....St. Catharines, Ont.
Northern Michigan Trans. Co.....Chicago.
Red Star Line .....New York.
Richelieu & Ontario Nav Co. .. Montreal, Can.
United Fruit Co .....Boston.

STEEL CASTINGS.
Macbeth Iron Co.....Cleveland.
Otis Steel Co.....Cleveland.
Seaboard Steel Casting Co.....Chester, Pa.

STEERING APPARATUS.
American Ship Building Co.....Cleveland.
Chase Machine Co.....Cleveland.
Dake Engine Co.....Grand Haven, Mich.
Detroit Ship Building Co.....Detroit.
Hyde Windlass Co.....Bath, Me.
Jenks Ship Building Co....Port Huron, Mich.
Marine Mfg. & Supply Co.....Cleveland.
Moulton Steering Engine Co.....New York.
Pawling & Harnischfeger .....Milwaukee.
Sheriffs Mfg. Co.....Milwaukee.

SUBMARINE DIVING APPARATUS.
Morse & Son, A. J.....Boston.
Schrader's Son, A.....New York.

SURVEYORS, MARINE.
Gaskin, Edward .....Buffalo.
Hynd, Alexander .....Cleveland.
Lovejoy, H. O.....Buffalo.
Matteson & Drake .....Philadelphia.
Parker Bros. Co., Ltd.....Detroit.
Nacey, James .....Cleveland.
Rice, Henry .....Buffalo.
Steel, Adam .....Cleveland.
Wood, W. J.....Chicago.

TESTS OF MATERIALS.
Hunt, Robert W. & Co.....Chicago.
Pittsburg Testing Laboratory, Ltd....Pittsburg.

TILING, INTERLOCKING RUBBER.
New York Belting & Packing Co...New York.

TOOLS, METAL WORKING, FOR SHIP AND ENGINE WORKS.
Allen, John F.....New York.
Watson-Stillman Co.....New York.

TOOLS, WOOD WORKING.
Atlantic Works, Inc.....Philadelphia.

TOWING MACHINES.
American Ship Windlass Co..Providence, R. I.
Chase Machine Co.....Cleveland.

TOWING COMPANIES.
Donnelly Salvage & Wrecking Co..... .....Kingston, Ont.
Great Lakes Towing Co.....Cleveland.
Midland Towing & Wrecking Co., Ltd.... .....Midland, Ont.

TRAPS, STEAM.
Kieley & Mueller .....New York.
Lunkenheimer Co. .....Cincinnati.
Sturtevant Co., B. F., ...Hyde Park, Mass.

TRUCKS.
Boston & Lockport Block Co.....Boston.

TUBING, SEAMLESS.
Shelby Steel Tube Co.....Pittsburg, Pa.

Buyers' Directory of the Marine Trade.—*Continued.*

VALVES, STEAM SPECIALTIES, ETC.

American Steam Gauge & Valve Mfg. Co. ..... Boston,
Ashton Valve Co. ..... Boston.
Crane Co. ..... Chicago.
Jenkins Bros. ..... New York.
Kieley & Mueller ..... New York.
Lunkenheimer Co. ..... Cincinnati.
Ross Valve Co. ..... Troy, N. Y.

VALVES FOR WATER AND GAS.

Ross Valve Co. ..... Troy, N. Y.

VARNISHES.

Detroit Varnish Co. ..... Detroit.
Detroit White Lead Works ..... Detroit.
Forest City Paint & Varnish Co. ..... Cleveland.
New Jersey Zinc Co. ..... New York.
Also Ship Chandlers.

VENTILATING APPARATUS FOR SHIPS.

Bayley & Sons Co., Wm. ..... Milwaukee, Wis.
Sturtevant, B. F. Co. ..... Hyde Park, Mass.

VESSEL AND FREIGHT AGENTS.

Boland, John J. ..... Buffalo.
Brown & Co. ..... Buffalo.
Elwell, Jas. W. & Co. ..... New York.
Fitzpatrick, C. W. & Co. ..... Chicago.
Fleming & Co., P. H. ..... Chicago.
Gilchrist & Co., C. P. ..... Cleveland.
Hall & Root ..... Buffalo.

VESSEL AND FREIGHT AGENTS—Con.

Helm & Co., D. T. ..... Duluth.
Hawgood & Co., W. A. ..... Cleveland.
Holmes, Samuel ..... New York.
Hutchinson & Co. ..... Cleveland.
Lester, S. S. ..... Quebec, Can.
McCarthy, T. R. ..... Montreal.
Mitchell & Co. ..... Cleveland.
Parker Bros. Co., Ltd. ..... Detroit.
Prindiville & Co. ..... Chicago.
Richardson, W. C. ..... Cleveland.
Sullivan, D. & Co. ..... Chicago.
Weeks, F. H. ..... New York.

WATER GAUGES.

Bonner & Co., Wm. T. ..... Boston
Lunkenheimer Co. ..... Cincinnati, O.

WIRE ROPE AND WIRE ROPE FITTINGS.

Baker, H. H. & Co. ..... Buffalo.
DeGrauw, Aymar & Co. ..... New York.
Upson-Walton Co. ..... Cleveland.

WHISTLES, STEAM.

American Steam Gauge & Valve Mfg. Co. ..... Boston,
Ashton Valve Co. ..... Boston.
Lunkenheimer Co. ..... Cincinnati.

WINDLASSES.

American Ship Windlass Co. ..... Providence, R. I.
American Ship Building Co. ..... Cleveland.
Hyde Windlass Co. ..... Bath, Me.
Jenks Ship Building Co. ..... Port Huron, Mich.
Marine Mfg. & Supply Co. ..... New York.

WINCHES.

American Ship Windlass Co. ..... Providence, R. I.
Georgian Bay Engineering Works ..... Midland, Ont.
Hyde Windlass Co. ..... Bath, Me.

WOOD WORKING MACHINERY.

Atlantic Works, Inc. ..... Philadelphia.

WRECKING AND SALVAGE COMPANIES.

Donnelly Salvage & Wrecking Co. ..... Kingston, Ont.
Great Lakes Towing Co. ..... Cleveland.
Midland Towing & Wrecking Co., Ltd. ..... Midland, Ont.
Parker Bros. Co., Ltd. ..... Detroit.

YACHT AND BOAT BUILDERS.

Bertram Engine Works Co., Ltd. ..... Toronto, Can.
Drein, Thos. & Son ..... Wilmington, Del.
Georgian Bay Engineering Works ..... Midland, Ont.
Truscott Boat Mfg. Co. ..... St. Joseph, Mich.
Willard, Chas. P. & Co. ..... Chicago.

YAWLS.

Drein, Thos. & Son ..... Wilmington, Del.

ALPHABETICAL INDEX OF ADVERTISERS IN THE MARINE REVIEW.

The star (*) indicates that the advertisement appears alternate weeks. For addresses see advertisements on pages noted.
The dagger (†) indicates that advertisement appears once a month.

LAKE SHORE AND MICHIGAN SOUTHERN RY.

Eastward	Arrive from West	Depart East
No 18, Southwestern Limited	.....	*1:50 a.m.
No. 22, Lake Shore Limited	*2:12 a.m.	*2:20 a.m.
No. 20, Chicago and Cleveland Exp.	*7:20 a.m.	.....
No. 28, New York and Boston Exp.	*7:40 a.m.	*8:00 a.m.
No. 40, Toledo and Buffalo Accom	†10:00 a.m.	†10:30 a.m.
No. 32, Fast Mail	*11:25 a.m.	*11:30 a.m.
No. 48, Accommodation via Sandusky	†1:40 p.m.	.....
No. 42, Boston-New York Express	.....	*11:45 a.m.
No 44, Cleveland and New York Spl.	.....	*3:00 p.m.
No. 46 Southwestern Express	.....	*3:10 p.m.
No. 116, Ashtabula Accommodation	.....	†4:30 p.m.
No. 6, Limited Fast Mail	*5:40 p.m.	*5:45 p.m.
No 26, 20th Century Limited	*7:40 p.m.	*7:43 p.m.
No. 10, Chicago, N.Y. & Boston Spl.	*7:30 p.m.	*7:50 p.m.
No. 16, New England Express	*10:30 p.m.	*10:35 p.m.
No. 2, Day Express	†9:10 p.m.	†9:25 p.m.
No. 126, Norwalk Accommodation	†7:55 a.m.	.....

Westward	Arrive from East	Depart West
No. 7, Exposition Limited	*12:50 a.m.	.....
No. 11, Southwestern Limited	*2:55 a.m.	.....
No 9, Day Express	.....	†6:10 a m.
No. 15, Boston and Chicago Special	*3:10 a.m.	*3:15 a.m.
No. 19, Lake Shore Limited	*7:15 a.m.	*7:25 a.m.
No. 23, Western Express	*10:30 a.m.	*10:35 a m.
No. 29, Southwestern Special	‡11:10 a.m.	.....
No 33, Southwestern Express	*12:25 p.m.	.....
No. 133, Cleve'and and Detroit Exp.	.....	*12:45 p.m.
No. 47, Accommodation	†11:00 a.m.	†3:00 p m.
No. 141, Sandusky Accommodation	.....	†3:10 p m.
No. 43, Fast Mail	*4:35 p.m.	*4:40 p.m.
No. 127, Norwalk Accommodation	.....	†5:10 p.m.
No. 37, Pacific Express	*6:50 p.m.	*7:20 p m.
No. 3, Fast Mail Limited	*10.50 p.m.	*10:55 p.m.
No 115, Ashtabula Accommodation	*8.30 a.m.	.....

*Daily. †Except Sunday. ‡Except Monday.
Trains Nos. 23, 28 and 37 run via Erie Station.
City Ticket Office, 237 Superior St.